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Charles Edward St. John

By ALFRED H. JOY

Those who knew Dr. Charles E. St. John would agree that abiding enthusiasm was the most outstanding characteristic of his long and successful career. His interests, however, were many and, happily, he was able to turn his attention from one activity to another and to put his whole soul into the problem before him.

St. John's adult life was divided into two distinct parts of nearly equal duration. The earlier period was taken up almost entirely with the numerous activities of college teaching while during the later period he gave himself unreservedly to pure research in entirely different surroundings.

The turning point came in 1908 when he was invited by Dr. George E. Hale to take up research work as a member of the staff of the Solar Observatory of the Carnegie Institution of Washington. In spite of the fact that he was then past fifty years of age and had previously given little attention to research work of any kind, he felt that the invitation was a clear call to a new field. His teaching work had been eminently successful, and he was loved and respected by his colleagues as the most influential man in the college where he had served for many years.

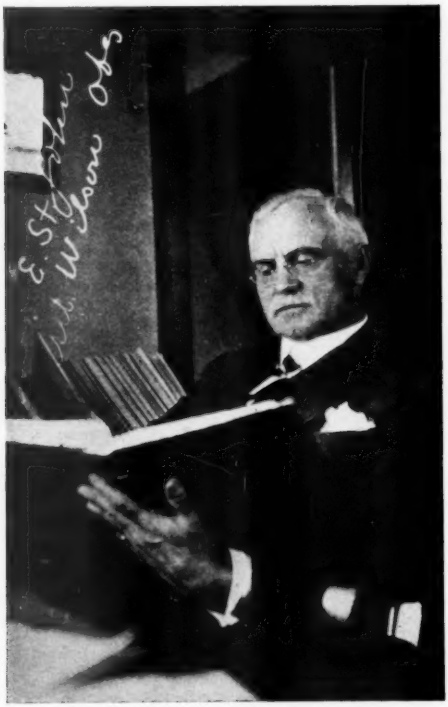
Charles Edward St. John was born at Allen, Michigan, March 15, 1857. After graduation at the Michigan Normal College, at the age of nineteen, ill health due to overstudy made it necessary for him to postpone further work for a period of ten years. From 1886 to 1892 he was an instructor in the Normal College, but during the same period he continued his advanced study at the Michigan College of Agriculture and the University of Michigan. In 1892 he went to Harvard for two years' study and then to Berlin for a year, after which he returned to Harvard for his doctor's degree which was awarded in 1896. These years imbued him with that love for physical investigation which later led him to Mount Wilson.

Following a year at the University of Michigan in 1896-97, St. John accepted the Chair of Physics and Astronomy at Oberlin College where he served as Associate Professor for two years and Professor for nine years. During the last two years, from 1906 to 1908, he also held the position of Dean of the College of Arts and Sciences.

It was at Oberlin in the year 1903-4 that I first met him and studied under his direction. The small classes in the graduate department of the College permitted close personal association between teacher and students. His interest in many of his students was continued in after years by correspondence and by visits when opportunity afforded. His

letters were always inspiring and helpful, although the chirography was not always easy to decipher. I had the privilege of renewing intimate acquaintance with him in 1915 at Mount Wilson where I worked with him for several years and even shared his bachelor apartment in Bowen Court for some time.

In his work in Oberlin College St. John showed the same energy and enthusiasm which characterized his later work at Mount Wilson. Al-



DR. ST. JOHN IN HIS STUDY

though he was not particularly pleased to have the young ladies of the College register in his department, his elementary courses were always well attended by both men and women. In his more advanced courses, however, he felt more at home and was at his best. His mathematical presentation possessed a remarkable clarity and his laboratory demonstrations were thoroughly prepared and beautifully carried out. In his lectures he often closed his eyes for considerable periods of time in order to concentrate upon the subject. His students always had the impression that he was completely wrapped up in his work.

On the campus he had the reputation of being quite absent minded. The story is told that, when riding a bicycle across the campus, he once bowled over the President of the College and caused considerable damage to his high silk hat.

In addition to his work in the department of Physics and Astronomy, St. John was Chairman of the Oberlin College Athletic Committee for many years. He called the meeting of the colleges of Ohio at which the Ohio Athletic Conference was organized and served as Chairman until he left the state. He also took an active part in community enterprises in Oberlin and served as member of the Oberlin Water Works Board and Chairman of the Board of Trustees of the Second Congregational Church for many years.

The strain of increasing responsibilities in Oberlin had begun to tell on his health in his last years there and this was one of the considerations which influenced him in his decision to go to Mount Wilson. He was not unacquainted with the staff or the work at the new Observatory for, beginning with the summer of 1898, he had spent a number of his vacations at the Yerkes Observatory at Williams Bay, Wisconsin, with Dr. Hale and some of the astronomers who later went to California to set up the Mount Wilson Observatory.

After arriving in California he spent several years in residence at the "Monastery" on Mount Wilson and was present when the old wooden building burned in 1909. Later, he rented a bungalow in Bowen Court, Pasadena, where he lived very simply until his last fatal illness. During the later years of his life he was greatly assisted by his devoted cousin, Mrs. Elvira Seeley, whose care over him relieved him from worry and responsibility.

St. John's enthusiasm for astronomical investigation knew no bounds. His program was an extensive one covering nearly all the fields of solar physics. Observations were limited only by the setting of the sun, while measures and reductions ran well into the night.

The outdoor life of the mountains strongly appealed to St. John. He loved the birds, the trees, and the flowers, and knew them all by name. Previously, he had been accustomed to spend part of the vacation on camping trips and went as far as Yellowstone and Glacier Parks, long before they were known as they are today. In California he found less time for such trips but he cherished the memory of a number of camping parties shared with other members of the Observatory staff. On account of his own evident enjoyment of nature and his unusual ability as a conversationalist, he was always the life of the outing party and even though, in moments of abstraction, he was often known to kick over the coffee pot, sit down on the camp fire, or fall overboard from the boat, his companions never felt that a trip was complete without him.

While studying for his degree at Harvard and Berlin Universities, St. John's interests were in the realm of light and electricity. His studies of the emission of light at high temperatures and of the strength

of lines in the spectrum of the electric spark led naturally to his later investigations pertaining to the origin of lines in the solar spectrum. Upon his arrival on Mount Wilson in 1908 he entered eagerly into Dr. Hale's plans for solar research with a mature mind and a practical skill in the use of instruments which brought immediate results. During the following twenty years he broadened his program from year to year and, with unfailing energy, met and solved a surprising number of problems in solar physics and made a remarkable contribution to the fundamental understanding of the spectrum of the sun.

The basis of practically all his investigations was the measurement of high-dispersion solar spectra photographed with the large spectrographs on Mount Wilson. The results of the accurate measures were applied with the greatest skill and daring to numerous problems in connection with the sun. Enduring patience, exacting attention to detail in observational technic, and balanced judgment in weighing and combining data were required. Minute consideration had to be given to the behavior of the electric arc which was generally used as the source of the comparison lines to which the measures of the solar lines were referred. Hundreds of plates and thousands of lines were measured.

This enormous collection of measures of solar lines led St. John and his colleagues to publish in 1930 a complete revision of Rowland's Table of Solar Lines. The wave-lengths of 22,000 lines were corrected and reduced to the International system. The chemical elements giving rise to each line, the intensity, temperature and pressure class, and excitation potential were given as far as possible. The Revised Table is in constant use by all who are engaged in a study of stellar or solar spectra.

The study of the wave-lengths and displacements of the calcium lines H and K was the first investigation undertaken by St. John at Mount Wilson. Later, the lines of other elements were measured. He separated the lines originating at low levels from those formed higher up in the atmosphere and thus attempted, for the first time, to sound the gaseous envelope of the sun. From a study of the velocities he was able to picture the circulation of the different layers.

The study of solar velocities could not be complete without a thorough knowledge of the sun's rotation. To this problem St. John gave a vast amount of time and effort. In the quest for greater accuracy, difficulties arose and the final results must devolve upon his colleagues. Spectrograms for this investigation now cover more than two complete sun-spot cycles.

Several of St. John's most laborious investigations were of a critical nature. In order to prepare the ground for his own work it was necessary to examine in detail any suggestions with regard to phenomena which might affect the wave-lengths of solar or comparison lines. Among these investigations was a careful search for the effects of anomalous dispersion on the Fraunhofer lines as suggested by Julius. The effect was found to be negligible. Evershed's discovery of radial motions about sun-spots was amply confirmed and extensively used in sub-

sequent work. Another critical work was the test of the gravitational displacement of the solar lines as predicted by Einstein's general theory of relativity, which is of especial interest and importance not only because of the far-reaching consequences of the theory itself but also because it shows St. John's fairness and his persistence in following up a problem until it was satisfactorily solved. In 1917, from the examination of a few lines of cyanogen in the solar spectrum, he concluded that there was no evidence for a red shift of the amount expected by Einstein. Further study, however, using hundreds of lines of iron, silicon, manganese, and titanium, in addition to a much larger number of cyanogen lines, convinced him that his earlier result was erroneous because

DR. ST. JOHN AT THE SPECTROGRAPH.

it was based on insufficient data. He took especial satisfaction in the outcome of the matter and became an ardent advocate of the relativity theory.

St. John's continued intensive attack on all problems pertaining to the spectrum of the sun enabled him finally to set up a consistent scheme of the physics of the solar atmosphere which was based on existing knowledge, much of which he himself had derived, of the factors which affect the solar spectrum, such as pressure, height, motion about spots, rotation, relativity effect, and the distribution of the chemical elements.

Although most of St. John's time was given to research on solar and

laboratory spectra he also collaborated in notable studies of the atmospheres of the planets Venus and Mars and some of the brighter stars.

Many of his researches were undertaken jointly with other members of the Observatory staff, particularly, Miss L. W. Ware and Mr. H. D. Babcock. He was always ready to acknowledge the assistance rendered by those who worked with him.

In the commissions of the International Astronomical Union St. John took an active part. For many years he served as President of the Commission on Standards of Solar Wave-lengths and succeeded in organizing an efficient attack on this fundamental problem among the solar observers in various parts of the world. From 1924 to 1934 he was President of the Commission on Solar Physics. He attended most of the meetings of the Union during these years. Also, for a number of years he was a member of the Commission on Solar and Terrestrial Relationships of the International Council of Scientific Unions.

St. John's wide interests may be inferred from his membership in numerous scientific societies, such as American Association for the Advancement of Science, American Astronomical Society, Astronomical Society of the Pacific, American Physical Society, American Mathematical Society, History of Science Society, and Société Astronomique de France. He was elected Associate of the Royal Astronomical Society in 1917 and member of the National Academy of Sciences in 1924.

Although, in disposition, he was somewhat retiring, St. John had a remarkable faculty for making and keeping friends. Among scientific men his friendships extended to all parts of the world but, in addition, he was loved and respected by a host of others in all walks of life. He had an unusually active interest in the members of his own family and did not spare himself when he could serve them. The University Club of Pasadena was almost a hobby with him and he devoted much time to its affairs. He was three times elected President of the Club in the years 1930-33.

Until the last few years of his life St. John was active in sports, which he enjoyed for the sake of the game itself. He played tennis and golf with great zest in his earlier years and later tried his hand at billiards.

In 1930, St. John was retired from the staff of the Mount Wilson Observatory by the Carnegie Institution of Washington and appointed Research Associate. He was thus able to continue much of his work. After his retirement he was frequently troubled by ill health, but he took his affliction philosophically and coöperated cheerfully with his physicians in withstanding the ravages of disease. On April 26, 1935, he died from an attack of pneumonia after an illness of only a few days. Until his last day he maintained his enthusiasm for life and asked for his field glasses so that he might better view the mountains and for the favorite books and friends which had meant so much to him.

In his life as a college professor St. John appealed to his students as a true teacher—painstaking, sympathetic, and inspiring—and to his col-

leagues as an able, conscientious, and efficient leader. In scientific research he was able to lay out a large and important program, to master its details, to recognize its essential features, and to push it through to completion in spite of unforseen difficulties. As a man he will be missed by many who were glad to call him a true friend and charming companion.

For the first time since the station was started thirty years ago, the Mount Wilson Observatory finds it necessary to record the death of one of its staff members. His investigations will be continued by loyal colleagues, but the inspiration of his presence and his whole-hearted enthusiasm will be lacking.

CARNEGIE INSTITUTION OF WASHINGTON,
MOUNT WILSON OBSERVATORY, NOVEMBER 4, 1935.

The Eclipse of 1935 December 25— An Umbral Eclipse of the Midnight Sun in the Antarctic

By ALEXANDER POGO

The Christmas eclipse of 1935 has the distinction of belonging to two groups of rare phenomena: it is the fifth solar eclipse within a calendar year, and it happens to be an umbral eclipse of the midnight sun in the Antarctic. Within the past three thousand years, an umbral eclipse of the midnight sun occurred but once in a calendar year having 5 solar eclipses: the annular eclipse of —373 December 29 Julian (December 24 Gregorian) occurred at lower culmination, near the South Pole, and it was the fifth solar eclipse both in the Julian and in the Gregorian calendar year. The interval of 2308 years or 842980 days between this eclipse and the eclipse of 1935 December 25 will be discussed below.

The partial eclipse of 1916 December 24—which preceded the eclipse of 1935 January 5 by one saros, and the eclipse of 1935 December 25 by one Metonic interval—formed the subject of two interesting papers by W. F. Rigge.[1] Partial eclipses of the midnight sun belong to three groups which might be designated as extrapolar, circumpolar, and transpolar, respectively. The first group includes partial eclipses of the midnight sun produced by a slight brushing—against the diurnal rotation—of the penumbra against a limited region which lies entirely beyond the pole, as seen from the sun, and which does not, therefore, include the pole; the eclipse described by W. F. Rigge, and several eclipses which immediately preceded it in the long terminal penumbral run of the solar saros series S1, belong to the extrapolar group; midnight eclipses

[1] The Solar Eclipse of 1916 December 24. *Monthly Notices R.A.S.*, **75**, 687-692, 1915. Eclipse of the Christmas Midnight Sun. POPULAR ASTRONOMY, **24**, 8-14, 1916.

of this type occur near the major penumbral limit, and are rare indeed. The second group includes eclipses of the midnight sun produced by the penumbra sweeping across the pole which is, therefore, included in the penumbral area; the partial eclipse[2] of 1935 June 30 belongs to the circumpolar group; a survey covering the second half of the XIXth century and the first third of the XXth shows that, during an average interval of ten years, there were, at both poles, about four partial eclipses of the midnight sun belonging to the circumpolar group. The third group includes eclipses of the sun, at lower culmination, by the penumbra which sweeps beyond the pole, as seen from the sun, during umbral eclipses whose tracks reach sufficiently high latitudes; such a transpolar partial eclipse of the midnight sun will occur during the total eclipse of 1936 June 19; while the umbra follows the tracks of the Siberian railroad, the zone of partiality on the American side of the North Pole will offer the spectacle of a partial eclipse of the sun at lower culmination; the statistical survey mentioned above shows that there were, in an average decade, at both poles, about five partial eclipses of the midnight sun belonging to the transpolar group.

The annular eclipse of 1917 December 14—which preceded the eclipse of 1935 December 25 by one saros—formed the subject of a valuable short paper by C. T. Whitmell[3] and of an elaborate study by W. F. Rigge.[4] Umbral eclipses of the midnight sun are a relatively rare phenomenon; those occurring within the Arctic Circle will be dealt with elsewhere, although we shall include the eclipse of 1891 June 6 in the discussion which follows. In the XIXth century, umbral eclipses of the midnight sun occurred three times: 1860 January 23 and 1878 February 2 in the Antarctic, and 1891 June 6 in Siberia; with the exception of the *Connaissance des Temps,* the almanacs failed, on these three occasions, to give a correct interpretation of the correctly computed circumstances of these eclipses. This was due to the stereotyped use of expressions like "central eclipse at noon," "centrale Verfinsterung im Mittage," etc.

In 1860—incidentally, a year with a transit of Mercury—an unusual annular eclipse occurred during the night of January 22-23; about 9 minutes before Greenwich mean midnight, the eclipse was central, approximately 1° from the South Pole, on a meridian which was only 5° E of Greenwich—a meridian which crossed France. The *Connaissance des Temps* used, in those days, as a standard expression, the non-committal "éclipse centrale au méridien"; the other almanacs used the stereotyped expression "at noon," or its German or Spanish equivalent, paying no attention to the numerical values of the time and of the longitude in this particular case.

In 1878—again a year which happened to contain a transit of Mer-

[2] See chart in POPULAR ASTRONOMY, **43**, 21, 1935.

[3] The Solar Eclipse of 1917 December 13. *Monthly Notices R.A.S.*, **76**, 408-411, 1916.

[4] The South Polar Eclipse of 1917 December 13. POPULAR ASTRONOMY, **25**, 346-358, 1917.

cury—the lapse of a saros brought a return of the midnight eclipse, on February 2; the midnight meridian shifted from France to the Rocky Mountains; the sun was at its lower culmination, about 6° from the South Pole, at $7^h\ 44^m$ U.T., on a meridian crossing the Great Salt Lake. The *Connaissance des Temps* correctly characterized the crucial phase as an "éclipse centrale à minuit vrai"; all the other almanacs used the misleading expression "at noon"; the *Annuaire* which is published, like the *Connaissance des Temps*, by the Bureau des Longitudes, and which copies the numerical data of the latter, failed to notice the unusual "minuit," and has the misleading "midi."

In the XIXth century, there was but one umbral eclipse of the midnight sun within the Arctic Circle; it occurred after the publication of Oppolzer's *Canon der Finsternisse*;[5] yet, the *Connaissance des Temps* was again the only almanac which gave a correct interpretation of the numerical values characterizing the crucial phase of the Siberian midnight eclipse; the eclipse was, incidentally, visible, in its partial phases, over wide areas of Europe, Asia, and North America; at $14^h\ 38^m$ U.T., the sun was in the zenith over the West Indies, it was night in Asia, and the eclipse, in longitude 110° E of Greenwich, a few degrees north of the Arctic Circle, in Siberia, occurred obviously at lower culmination. The *Annuaire* again copied its numerical data from the *Connaissance des Temps*, without paying attention to the unusual "minuit," thus joining the other almanacs in their misleading use of the expression "at noon"; the *Anuario del Observatorio de La Plata*, which borrowed the eclipse data from the *Connaissance des Temps*, has the correct "media noche verdadera."

In Oppolzer's *Canon*, these three exceptional eclipses of the XIXth century are correctly marked as midnight eclipses. Their case should not be confused with legitimate cases of disagreement, due not to misleadingly used standardized expressions but to slightly differing values of the elements, to variations in the computational methods, or to the adoption of special hypotheses—of the altitude of the polar cap, for instance; these causes, acting separately or together, may shift the computed curve of centrality to the other side of the pole, changing a midnight point into a noon point, or *vice versa*. As an example of such a computational shifting of the central line to the opposite side of the pole, we shall quote the case of the eclipse of 1917 December 14. The tracks of the annulus undoubtedly ran over the South Pole, producing, at $9^h\ 23^m.4$ U.T., both an annular eclipse at noon in longitude 37° 47′ E, and an annular eclipse at midnight on the continuation of the same meridian beyond the pole, in longitude 142° 13′ W. Did the line joining the centers of the eclipsed sun and of the eclipsing moon cross the meridian in longitude 37° 47′ E or in longitude 142° 13′ W? The *American Ephemeris and Nautical Almanac* (which supplied the eclipse section to the British *Nautical Almanac*) states that the central eclipse at local

[5] Denkschriften d. Akademie, math.-naturw. Cl., Bd. 52, Wien 1887.

apparent midnight occurred, at $9^h\,23^m.4$ U.T., in longitude 142° 12′.8 W, and in latitude 89° 56′.6 S. According to the *Connaissance des Temps* (which supplied the eclipse section to the *Almanaque Náutico* of San Fernando, and which was the unacknowledged source of the eclipse section of the *Berliner Astronomisches Jahrbuch* for 1917), the central eclipse at local apparent noon occurred, at $9^h\,23^m.4$ U.T., in longitude 37° 47′ E, and in latitude 89° 57′ S. In other words, the South Pole was about four statute miles from the convex side of the central line, according to the Nautical Almanac Office, and it was from three to four miles from the concave side of the track of the axis of the umbral cone produced beyond the apex, according to the Bureau des Longitudes. Oppolzer's *Canon* gives the coördinates of the point of centrality at culmination as 38° E and 90° S, and the time of the ecliptic conjunction as $9^h\,17^m.7$ U.T.; the time and the terrestrial longitude indicate an upper culmination; the *Canon* considers, therefore, the eclipse of 1917 December 14 as an eclipse with a noon point of centrality.

Let us pass, from the eclipse of 1917 December 14, to the eclipse of 1935 December 25, and to the solar saros series S13. The size and the shape[6] of the zone of partiality of the Christmas eclipse of 1935 are about the same as in the case of the previous eclipse; the southern part of South America, which was within the sunrise loop in 1917, is now within the northern limit of simple contact; the sunrise loop of 1935 covers New Zealand, where decreasing partial phases will be visible Thursday morning, on the 26th of December. The tracks of the annulus which ran, in 1917, from the American quadrant, over the South Pole, into the Australian quadrant, run this time from the Australian into the African quadrant, leaving the pole on the convex side. The recession of the tracks of the annulus from the South Pole will continue in the case of the midnight eclipses of 1954 January 5 and 1972 January 16, because the ecliptic conjunctions will occur at increasing distances west of the ascending node, with correspondingly increasing southern latitudes of the moon, while the southern declination of the sun will decrease after the maximum reached during the quasi-solstitial eclipse of 1935. During the winter eclipses of 1990, 2008, and 2026, the axis of the umbra—or, rather, its continuation beyond the vertex of the umbral cone,—will reach the earth at sunset; during the sunset eclipse of 2044, it will fail to touch the earth, the annular but not central eclipse being the result of the brushing of the earth against the cone of the umbra produced beyond its apex. The terminal run of penumbral eclipses will be short, the date of the last partial eclipse of the solar saros series S13 being, probably, 2206 June 7. The first umbral eclipse of the saros series S13 deserves to be mentioned: the total eclipse of the midnight sun in the Arctic, 1070 July 10, makes S13 a saros series containing midnight eclipses at both ends of the umbral run; the ascending-node saros series S35, S12, and S212 also contain midnight eclipses at both

[6] See chart in POPULAR ASTRONOMY, **43**, 23, 1935.

ends of their respective umbral runs; these saros series, forming a cluster in Table II, will be discussed elsewhere.

To the solar saros series S13 belong at least fourteen eclipses mentioned in European and Asiatic annals. The eclipse of 1124 August 11 is mentioned in English, German, Polish, and Bohemian chronicles, and in Fulcher's Historia Hierosolymitana;[7] its tracks of totality ran from North America, across Scandinavia, into Central Asia. The eclipse of 1178 September 13 which followed at the interval of one exeligmos, is mentioned in English, Belgian, Scandinavian, German, and Italian chronicles;[8] its tracks of totality ran from North America, over France and the Mediterranean, into the Arabian Sea. At least twelve eclipses of series S13—belonging to two different exeligmos sequences—are mentioned in Chinese documents:[9] the years of these eclipses are: 998,

TABLE I

SOLAR SAROS SERIES S13

					°						°						°
1	p	944	Apr	25.44	39.9	34	t	1539	Apr	18.59	37 2	67	p	2134	Apr	24.45	34.1
2	p	962	May	6.75	50.4	35	t	1557	Apr	28.92	47.8	68	p	2152	May	4.75	44.8
3	p	980	May	17.05	60.9	36	t	1575	May	10.23	58.3	69	p	2170	May	16.0	
4	p	998	May	28.35	71.3	37	t	1593	May	30.55	68.8	70	p	2188	May	26.3	
5	p	1016	Jne	7.65	81.8	38	t	1611	Jne	10.86	79.3	71	?	2206	Jne	7.6	
6	p	1034	Jne	18.96	92.2	39	t	1629	Jne	21.16	89.7						
7	p	1052	Jne	29.26	102.6	40	t	1647	Jul	2.47	100.2						
8	t	1070	Jul	10.57	113.1	41	t	1665	Jul	12.78	110.6						
8	t	1088	Jul	20.88	123.6	42	t	1683	Jul	24.09	121.1						
10	t	1106	Aug	1.19	134.1	43	t	1701	Aug	4.39	131.6						
11	t	1124	Aug	11.51	144.7	44	t	1719	Aug	15.71	142.1						
12	t	1142	Aug	22.83	155.4	45	t	1737	Aug	26.02	152.7						
13	t	1160	Sep	2.16	166.1	46	t	1755	Sep	6.34	163.3						
14	t	1178	Sep	13.50	176.8	47	t	1773	Sep	16.66	174.0						
15	t	1196	Sep	23.84	187.7	48	t	1791	Sep	27.98	184.8						
16	t	1214	Oct	5.18	198.6	49	t	1809	Oct	9.31	195.6						
17	t	1232	Oct	15.54	209.6	50	t	1827	Oct	20.65	206.5						
18	t	1250	Oct	26.89	220.7	51	at	1845	Oct	30.99	217.4						
19	t	1268	Nov	6.26	231.8	52	a	1863	Nov	11.33	228.5						
20	t	1286	Nov	17.62	242.9	53	a	1881	Nov	21.68	239.5						
21	t	1304	Nov	27.99	254.1	54	a	1899	Dec	3.03	250.7						
22	t	1322	Dec	9.36	265.3	55	a	1917	Dec	14.39	261.8						
23	t	1340	Dec	19.73	276.5	56	a	1935	Dec	25.74	273.0						
24	t	1358	Dec	31.10	287.7	57	a	1954	Jan	5.10	284.2						
25	t	1377	Jan	10.47	298.9	58	a	1972	Jan	16.45	295.4						
26	t	1395	Jan	21.83	310.1	59	a	1990	Jan	26.81	306.6						
27	t	1413	Feb	1.20	321.2	60	a	2008	Feb	7.16	317.7						
28	t	1431	Feb	12.56	332.3	61	a	2026	Feb	17.50	328.8						
29	t	1449	Feb	22.91	343.3	62	(a)	2044	Feb	28.84	339.9						
30	t	1467	Mar	6.26	354.2	63	p	2062	Mar	11.18	350.9						
31	t	1485	Mar	16.60	5.0	64	p	2080	Mar	21.50	1.8						
32	t	1503	Mar	27.94	15.8	65	p	2098	Apr	1.82	12.6						
33	t	1521	Apr	7.27	26.5	66	p	2116	Apr	13.14	23.4						

Julian calendar: eclipses 1 to 36.

Gregorian calendar: eclipses 37 to 71.

p — partial
t — total
at — annular-total
a — annular
(a) — ann., non-central
? — part. still possible

[7] F. K. Ginzel. Astronomische Untersuchungen über Finsternisse. Sitzungsber. d. Akad., math.-naturw. Cl., Bd. 88, Abt. 2, 694-697. Wien 1883.

[8] *Ibid.*, 715-717.

[9] Pierre Hoang. Catalogue des éclipses de soleil et de lune. Variétés sinologiques No. 56. Chang-hai, Imprimerie de la Mission catholique, 1925.

1106, 1160, 1214, 1268, and 1322, in the first sequence, and 1358, 1413, 1467, 1521, 1575, and 1629, in the second. It will be noticed that the eclipse of 998 May 28 was a partial one, and that the partial eclipse of 1052 June 29 is not mentioned; the eclipse of 1106 August 1 was "predicted but did not occur" (the southern limit of simple contact was in Siberia); the noon points of the second group of Chinese eclipses form an exeligmos loop north of the equator. The eclipses of 1196 September 23 and 1250 October 26, separated by one exeligmos, must have been conspicuous in the Maya territory.

Let us pass, from this astronomical and historical survey of the saros series S13, to umbral midnight eclipses in the Antarctic. According to the data of Oppolzer's *Canon*, the 8000 solar eclipses between 1208 B.C. and A.D. 2161 include 67 midnight eclipses in the Antarctic. Although, as we shall see below, their exact number cannot be ascertained, several valid general conclusions may be drawn from this representative group of 67 midnight eclipses. Most midnight eclipses in the Antarctic are annular; our group of 67 contains 44 annular, 3 annular-total, and 20 total eclipses; when the earth is in the perihelion arc, the shadow of the moon is short; if the moon happens to be near perigee, the vertex of the umbral cone will reach the surface of the globe beyond the South Pole, as seen from the sun, causing a total midnight eclipse; if the moon is not within a few days of perigee, the vertex of the short umbra will not reach the regions beyond the pole, and the midnight eclipse will be annular; annular-total midnight eclipses constitute a case of transition, near the ends of the perigee arc. The group of 67 midnight eclipses includes one non-central total and three non-central annular eclipses; they constitute a transition to non-central sunset or sunrise eclipses, and may occur at the end of an ascending-node run of midnight eclipses or at the beginning of a descending-node run.

The seasonal distribution of the 67 umbral midnight eclipses in high southern latitudes shows, of course, a clustering in the winter-solstice arc; the earliest Gregorian date of an umbral midnight eclipse in the Antarctic was October 24, about one month after the autumnal equinox; at the other end of the winter arc, the exceptionally late Gregorian dates

TABLE II

SEQUENCES OF SAROS SERIES CONTAINING UMBRAL MIDNIGHT ECLIPSES IN THE ANTARCTIC

Ascending node				Descending node				
X′	Z′	X′	Z′	Z″	X″	Z″	X″	Z″
187		189					30	
210		212				6	7	8
	11	12	13		205	206	207	
		35	36		182		184	
		58		158				

were February 19 and February 22, about one month before the vernal equinox; the corresponding extreme limits, expressed in longitudes of the ecliptic conjunctions, were 211° and 333°. About 95 per cent—64 of our 67 eclipses—occur on Gregorian dates ranging from November 4 to February 2, limiting the midnight-eclipse region of the winter-solstice arc to longitudes between 222° and 313°. About 85 per cent of the midnight eclipses occur within one month from the winter solstice, on Gregorian dates varying between November 23 and January 25.

The distribution of the geographical latitudes of the midnight points of these 67 eclipses follows:

—90°	1 ecl.
—89°	8 "
—88°	7 "
—87° to —81°	35 "
—80° to —70°	16 "

Oppolzer's *Canon* gives the geographic coördinates to the nearest degree; the sixteen high latitudes at the top of our list refer, therefore, to eclipses whose midnight points are, according to the *Canon*, within 2½ degrees from the South Pole. It is clear that, in the case of some of these eclipses, a change in the numerical values of the elements may give computational results indicating a shifting of the tracks to the other side of the pole. There are, in the *Canon*, in addition to our 67 midnight eclipses, twenty-two eclipses with noon points in latitudes within 2½ degrees from the South Pole. Two of these eclipses may be disregarded, because they occurred two and three weeks, respectively, before the vernal equinox, when an insufficient portion of the polar region faced the sun to make a midnight eclipse possible. The distribution of the geographical latitudes of the noon points of the remaining 20 additional eclipses is, according to the *Canon*:

—90°	6 ecl.
—89°	6 "
—88°	8 "

TABLE III

ECLIPSE CYCLES

Months	d	595 years (217316 days) d	1154 years (421490 days) d
Synodical	29.530588	× 7359 = 217315.60	× 14273 = 421490.08
Nodical	27.212220	× 7986 = 217316.79	× 15489 = 421490.08
Tropical	27.321582	× 7954 = 217315.85	× 15427 = 421490.05
Sidereal	27.321661	× 7954 = 217316.49	× 15427 = 421491.26
Anomalistic	27.554550	× 7887 = 217322.74	× 15296½ = 421488.17
Years	**d**	**d**	**d**
Ecl. (A.D. 1500)	346.61990	× 627 = 217330.68	× 1216 = 421489.80
Julian	365.25000	× 595 = 217323.75	× 1154 = 421498.50
Gregorian	365.24250	× 595 = 217319.29	× 1154 = 421489.84
Trop. (A.D. 1500)	365.24222	× 595 = 217319.12	× 1154 = 421489.52
Sidereal	365.25636	× 595 = 217327.53	× 1154 = 421505.84
Anom. (A.D. 1500)	365.25963	× 595 = 217329.48	× 1154 = 421509.61

These 20 additional eclipses with potential midnight points belong to fifteen of the twenty saros series listed in Table II, and precede or follow, by a saros or two, the corresponding runs of midnight eclipses; their Gregorian dates range between October 26 and February 4; thirteen of these additional eclipses occur within one month from the winter solstice; five of these thirteen eclipses have, according to the *Canon*, noon points in latitude —90°, and the eclipse of 1917 December 14, discussed above, is one of these five. It is practically certain that, in the case of these five and of some of the other additional eclipses, a change in the elements adopted would shift the computed tracks to the other side of the South Pole, thus increasing the number of midnight eclipses; on the other hand, some of the sixteen eclipses with midnight points within 2½ degrees from the South Pole would have to be dropped from our original list of 67. We may, therefore, assume that the number of umbral eclipses of the midnight sun in the Antarctic, between 1208 B.C. and A.D. 2161, is not far from 70.

The distribution of these three score and ten eclipses over the thirty-three centuries of the *Canon* reveals a periodicity of, roughly, six centuries, and will be discussed elsewhere, in connection with the variations of the number of saros series running simultaneously. It would be misleading to state that the average number of southern midnight eclipses is two per century, on account of the periodically distributed gaps, of about two centuries each; these gaps correspond to the maxima of the frequency curve of saros series running simultaneously; see Figure 4 in the January issue.[10] One of the principal causes of these gaps, the period of 595 years, will be discussed at the end of the present paper.

The 67 midnight eclipses of our original group belong to twenty saros series listed in Table II; as previously stated, the additional 20 eclipses with potential midnight points belong to fifteen of these twenty saros series. Table II shows these series arranged in a manner permitting a comparison with the exeligmos sequences of Table VI of the paper published in the June-July issue.[11] The hybrid saros series S158 and S182

TABLE IV

ANTARCTIC MIDNIGHT ECLIPSES
AND THE PERIOD OF 1154 YEARS (421490 DAYS)

Gregorian Calendar		
S11	S12	S13
.....	745 Dec 2 a 250°	.....
(—391 Dec 13 a 262°)	763 Dec 13 a 261°	(1917 Dec 14 a 262°)
—373 Dec 24 a 273°	781 Dec 23 a 272°	1935 Dec 25 a 273°
—354 Jan 3 a 284°	800 Jan 4 a 284°	1954 Jan 5 a 284°
—336 Jan 15 a 295°	818 Jan 14 at 295°	1972 Jan 16 a 295°
.....	836 Jan 25 at 306°	.....

[10] POPULAR ASTRONOMY, **43**, 12, 1935.
[11] POPULAR ASTRONOMY, **43**, 342, 1935.

are represented by the exceptionally late eclipses mentioned above, —793 March 2 and —160 February 22, respectively; these two eclipses are near the beginning of short umbral runs. All the other saros series of Table II are minor series; this is due to the fact that a normal umbral eclipse of the midnight sun in the Antarctic occurs when the sun is both near the major umbral limit and in the winter-solstice arc; the eclipse must, therefore, be near the end of a long umbral run of an ascending-node saros series, or near the beginning of a long umbral run of a descending-node saros series. If the positions of the earth and of the moon in their respective orbits are favorable for an early start of a run of midnight eclipses, a minor saros series may contain six or seven such eclipses; see Tables IV and V. The sequences formed by the saros series of Table II permit us to study the periodicity of groups of midnight eclipses occurring under similar circumstances. For the purposes of the present paper, we shall select the periods of 1154 and of 521 years; see Tables III, IV, and V.

The period of 1154 years differs from the period of $586 \times 2 = 1172$ years by one saros. A glance at Table III shows that eclipses separated by 421490 days occur at the same distance from the corresponding equinoxes; this is illustrated, in Table IV, by the longitudes of the ecliptic conjunctions and by the corresponding Gregorian dates of the midnight eclipses of the saros series S11, S12, and S13; the two eclipses in parentheses belong to our list of 20 additional eclipses with potential midnight points of centrality. The fractional number of anomalistic months contained in 421490 days shows that eclipses separated by 1154 years occur with the positions of perigee and apogee interchanged; if we double the interval, we see that eclipses separated by 2008 years or 842980 days find the moon in the same arc of its orbit, with respect to perigee or apogee; runs of midnight eclipses belonging to the saros series Sn and S(n±2) correspond, therefore, to a repetition, at intervals of 2008 years, of very similar conditions.

The period of 521 years is illustrated by the ascending-node sequences of Table V. Midnight eclipses separated by 190295 days or 27185 weeks fall on about the same date, in the Julian calendar, and on about

TABLE V

ANTARCTIC MIDNIGHT ECLIPSES AND THE PERIOD OF 521 YEARS (190295 DAYS)

Julian Calendar

S58	S35	S12	S212	S189
	188 N 6 We			
	206 N 17 Mo			
—297 N 29 Su	224 N 28 Su	745 N 28 Su		
—279 D 9 Fr	242 D 9 Fr	763 D 9 Fr	1284 D 8 Fr	
—261 D 21 Th	260 D 19 We	781 D 19 We	1302 D 20 Th	
	278 D 31 Tu	799 D 31 Tu	1320 D 30 Tu	
	297 J 10 Su	818 J 10 Su	1339 J 10 Su	1860 J 11 Mo
		836 J 21 Fr		1878 J 21 Sa

the same day of the week; the corresponding Gregorian dates vary, of course, with the longitudes of the ecliptic conjunctions. The period of 521 connects, as could be expected, several midnight eclipses which belong to calendar years with 3 lunar and 4 solar eclipses; thus, the Friday midnight eclipses of 242, 763, and 1284, listed in Table V, belong to years which contained 3 lunar and 4 solar eclipses, both in the Julian and in the Gregorian calendar; similarly, the Wednesday midnight eclipses of 1414 December 12 and of 1935 December 12 Julian, separated by 521 years, belong to Julian calendar years with 3 lunar and 4 solar eclipses.

Midnight eclipses in the Antarctic, on the one hand, and the southernmost parts of the loops or of the northern branches of the corresponding exeligmos curves, on the other, are connected by the 33-saros or 11-exeligmos period of 595 years. Table III shows that the average group of $223 \times 33 = 7359$ lunations is about 8 days shorter than 595

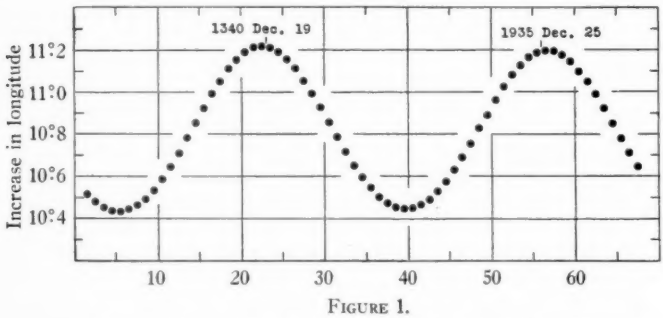


FIGURE 1.

INCREASE IN LONGITUDE OF SUCCESSIVE ECLIPTIC CONJUNCTIONS OF SOLAR SAROS SERIES S13.

Julian years, and about 3½ days shorter than 595 tropical or 595 Gregorian years; eclipses belonging to a given saros series, and separated by a 33-saros interval occur, therefore, in the same part of the ecliptic. Table I illustrates the 595-year period; Julian dates, such as 980 May 17 and 1575 May 10, differ by about a week; Gregorian dates, such as 1593 May 30 and 2188 May 26, or 1611 June 10 and 2206 June 7, differ by about half a week.

Figure 1 shows the influence of the perihelion and of the aphelion on the longitude of the successive ecliptic conjunctions of the saros series S13; if we plot the differences of longitude of eclipses separated by 33 saros intervals, we find a sinusoidal curve with a maximum of 3°.53, near perihelion, and a minimum of 2°.45, near aphelion. Figure 2 shows the fluctuations of the fraction of a day by which the duration of the successive saros intervals of series S13 exceeds 6585.0 days; it reflects, in addition to the seasonal changes in the rate of advance of the eclipsed sun, the influence of the varying speed of the eclipsing moon in its orbit;

unlike Figure 1, which is independent from the shape of the exeligmos curves, Figure 2 varies considerably, from one saros series to another, in amplitudes and slopes; these matters will be discussed elsewhere, in connection with exeligmos curves.

If a saros series contains umbral eclipses of the midnight sun in the Antarctic, they will occupy, on a diagram of the type reproduced in Figures 1 and 2, a position near the first maximum, in case of a descending-node saros series, or near the second maximum, in an ascending-node saros series. The eclipses which follow or precede them, at 595-year intervals, will belong to the second or first maximum, respectively. These central eclipses, occurring in the general neighborhood of the node, find the sun near its maximum southern declination, and the moon near the ecliptic; these central eclipses belong, therefore, to the southernmost part of the exeligmos loops or of the northern branches of the exeligmos curves, and are separated by 33 saros intervals from the corresponding eclipses of the midnight sun in the Antarctic. The total eclipse of 1340 December 19, belonging to the American exeligmos sequence of saros series S13, had its noon point of centrality off the Pacific coast of Panama, at the southernmost point of the northern branch of the exeligmos curve; it is connected, by the 33-saros interval, with the midnight eclipse of 1935 December 25.

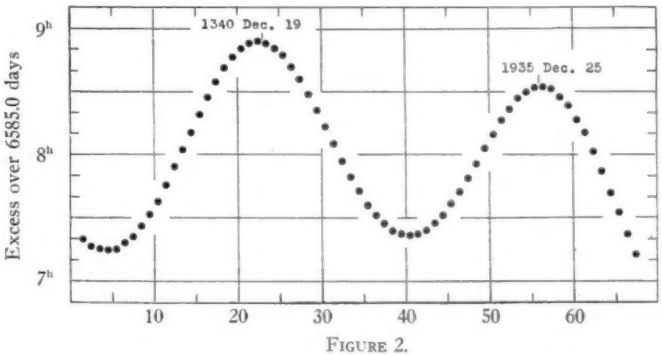


FIGURE 2.

DURATION OF INTERVALS BETWEEN SUCCESSIVE ECLIPSES OF SOLAR SAROS SERIES S13.

CARNEGIE INSTITUTION OF WASHINGTON,
SEPTEMBER 17, 1935.

Some New Trends in Stellar Spectroscopy

By OTTO STRUVE

(Continued from page 568.)

Turbulence

With the accumulation of accurate measurements, departures from the square-root law were recorded at various observatories. At the Yerkes Observatory numerous cases of such departures were found by Struve, Elvey, Morgan, and Hynek. Shajn at Simeis and Thackeray at Cambridge announced similar results. The discussion and interpretation of the observational data presented considerable difficulty.

The theory of Schütz was carefully tested in the laboratory and found to be correct. Minnaert definitely confirmed it for the sun. Yet, there were stars which gave distinctly discordant results. Particularly striking is a comparison of 17 Leporis, ϵ Aurigae, α Persei, and Procyon. If we examine the same multiplet, say one of Fe II, in these four stars, and plot the observed intensity against the theoretical multiplet intensity, we obtain for each star an inclined line. The gradient of this line is steep for 17 Leporis, less steep for ϵ Aurigae, and still flatter for α Persei and Procyon.

Similar results were found for the gradients of the O II lines in B stars and of the Fe I lines in F stars. The phenomenon was apparently quite complicated, and a detailed investigation had to be undertaken in order to solve it.

Struve and Elvey obtained accurate measurements of many lines in a number of stars and constructed for each spectrum a "curve of growth." The results were very enlightening. In most cases the curves resembled in shape those obtained by Minnaert and Slob for different temperatures. But in 17 Leporis all points were on the first branch of the curve, where A is proportional to N. For ϵ Aurigae the flat part of the curve fell at $A = 1.0$ Å and for α Persei at $A = 0.4$ Å. The resulting temperatures, namely 3×10^7 degrees for 17 Leporis, 2×10^6 degrees for ϵ Aurigae, and 3×10^5 for α Persei are, of course, impossible, being readily disproved by the theory of ionization. We were forced to conclude that, notwithstanding the agreement in the shapes of the curve with the theory by Schütz, thermal Doppler-effect cannot be responsible for the different gradients in the stellar lines.

The only satisfactory explanation that has thus far been suggested is that there are violent turbulent motions in the atmospheres of some stars, and that these motions are responsible for the upward shift of the curves of growth. The formulae remain practically the same as in the case of thermal agitation, the only difference being that turbulence does not depend on atomic weight or temperature. The most probable turbu-

lent velocity is 67 km/sec for 17 Leporis, 20 km/sec for ϵ Aurigae, and 7 km/sec for α Persei. It is zero for the sun, Sirius, Vega, τ Scorpii, γ Pegasi, etc.

Quite recently Dunham has announced similar results for α Persei, for which he finds a turbulent velocity of 5 km/sec—about twice what would be expected from thermal Doppler effect. An important confirmation of the theory was also obtained by Berman, who derived a turbulent velocity of 10 km/sec for R Coronae Borealis. In this work Berman made use of theoretical intensities of "super-multiplets" derived by Goldberg and by Menzel at the Harvard Observatory.

An interesting test of the theory of turbulence should be possible in the study of the line-contours. These should, of course, give Doppler-contours or Doppler-cores which are easily observable. Actual measurements have not yet been made, but the widths of the lines in turbulent stars are in entire agreement with the theory. Moreover, the stronger metallic lines in 17 Leporis and in ϵ Aurigae are definitely not of the Unsöld type and, qualitatively at least, agree with the Doppler contour.

Astrophysically, the study of turbulence in stellar spectra promises to lead to many interesting developments. At present it would seem that turbulence is more pronounced in the supergiants than in the normal giants or in the dwarfs. However, not all supergiants have large turbulent velocities. The latter are common in supergiants of class B, but are evidently rare in the later types.

In the derivation of turbulent velocities at the Yerkes Observatory the assumption was made that the motions in the line of sight are distributed according to the law of Maxwell. For thermal motions this assumption is necessary. For turbulent motions affecting large volumes of gas the distribution of velocities need not be Maxwellian.

The shape of the curve of growth depends upon the assumed velocity-distribution. For a Maxwellian distribution the curve never becomes completely horizontal, but approaches a definite slope in its central portion. For a velocity-distribution which is a constant between zero and a maximum value, V, the curve is horizontal in the limiting case. Such a distribution of velocities would be observed in a gas in which equal volume-elements are all moving with the same velocity, but in random directions. In nature this type of motion is realized in the case of interstellar gases. The absorption lines produced by a gas that participates in the rotation around the massive center of the galaxy are identically the same as those produced by a gas in which the motions are all equal but the directions are distributed at random.

It is now of interest to invert the problem and to derive the law of turbulent motions in stellar atmospheres from the observed curves of growth. This involves the solution of an integral equation, but in view of the great uncertainty of the existing observational material no refinements are required in the solution. The problem is now being attacked by L. G. Henyey of the Yerkes Observatory who, in collaboration with Professor Walter Bartky, has derived many interesting prop-

erties of the curves of growth. An admirable summary of certain phases of the problem was given by Minnaert in a recent issue of *The Observatory*.

Many phenomena that have been puzzling us in the past are now satisfactorily explained. The star 17 Leporis, for example, is undergoing changes in the appearance of its lines. At times the metallic lines are fairly narrow and sharp while at other times they are broad and diffuse. There is good reason to attribute the absorption lines to expanding shells—like in stars of the P Cygni type—but the puzzle is this: When the lines are narrow most of them are much more conspicuous than when they are broad. The hydrogen lines, however, are strongest when these metallic lines are broad and inconspicuous and several strong lines of iron, for example λ 4924, do not change a great deal in intensity, but remain quite strong even when other lines of iron, for example λ 4508, 4520, and others, are practically invisible.

The explanation of this interesting phenomenon is quite simple once we accept the turbulence hypothesis. When the lines are narrow the turbulence is relatively small and the curve of growth reaches its flattest portion at a relatively low total absorption. When the lines are broad the turbulent velocities are large and the curve of growth continues along the left hand branch where A is proportional to N, until much larger values of A have been reached. In other words, strong lines which are saturated no matter what the dispersion in velocities are strengthened in the broad-line stage of the star, while weak lines are reduced in central intensity and thereby are made inconspicuous. It should be possible from measurements of the Balmer continuous absorption to prove that the strengthening of the hydrogen lines is caused by increased turbulence and not by increased abundance of hydrogen atoms.

A similar explanation probably holds in the case of the abnormal strengthening of many lines in ε Aurigae during the eclipse of this binary.

Not all phenomena originally attributed to the gradient effect can be explained by turbulence. The next section will explain one of these phenomena, but others remain doubtful. For example, Morgan found some years ago that a few A stars show an extremely flat gradient for FeI: the faint, low-level lines are much stronger in 73 Draconis than in ε Serpentis, although the temperatures of these two stars are about the same. The phenomenon is not in agreement with the Boltzmann principle. On the other hand, it is improbable that 73 Draconis would have a particularly turbulent atmosphere. Nor do the line contours resemble those of typical turbulent stars.

The Helium Anomaly

The successful application of a theory to a group of observed phenomena not infrequently leads an investigator to apply it to other observational results. Sometimes such an extension of the theory to material for which it was not originally intended proves fruitful, but

occasionally an incorrect application may retard progress in other fields. The latter happened not long ago when, after the success of the theory of turbulence, we applied it to a phenomenon which we shall call the helium anomaly.

Several years ago the writer called attention to the fact that the relative intensities of helium triplets and singlets were not the same in all stars. Since the excitation potentials of these lines are almost identical, the theory of ionization predicts that the ratio of intensity of a triplet line to a singlet line should be constant in all stars. Accordingly, the conclusion was made that conditions in stellar atmospheres do not resemble those of thermodynamic equilibrum sufficiently to permit the application of the theory of ionization to the helium lines.

Laboratory experiments by Ornstein, Burger, and Kapuczinski had shown that in the discharge tube the relative intensities of the helium triplets and singlets vary with pressure, the singlets becoming relatively more intense as the pressure is reduced. These authors suggest that this is caused by the reduction in the number of collisions which alone are able to lift a helium atom from the singlet system into the triplet system. The ground level of the helium atom belongs to the singlet system and since there are practically no inter-system lines, radiation phenomena will merely shift the atom from one singlet level to another; it requires a collision to remove it into the triplet system.

Contrary to these laboratory results, stellar spectra show that the triplets are relatively stronger in the giants (or in low pressures) than in the dwarfs (or in high pressures). In order to make progress a search was made for similar effects in other atoms. An examination of O II in B-type stars seemed at first to indicate that there was a similar difference in the relative intensities of the doublets and quartets. Thus in the giants the quartet lines 4346 and 4349 are relatively much stronger than the doublet lines 4347 and 4351, while in the dwarfs the difference in intensity is but slight.

A more careful investigation of the O II lines, however, revealed that not all quartets were strengthened in the giants, and it finally became apparent that the entire phenomenon was only one of the many manifestations of the turbulence effect.

Having thus accounted for the variations of the O II doublets and quartets it was natural to explain in a similar manner the helium anomaly. Indeed, the triplets are systematically stronger than the singlets. Consequently, in stars having large turbulent velocities and hence large gradients, the singlets would appear relatively weaker than in normal stars. The evidence seemed fairly convincing and no attempt was made for several years to apply the theory of turbulence to the helium lines.

With the help of Morgan, accurate measurements of the helium intensities have now been made by Rudnick at the Yerkes Observatory. His results are interesting: the gradient effect does not account for the helium anomaly. The following tentative results are based upon visual estimates by the writer for the lines 4009, 4026, 4388, and 4472:

1. Singlets and triplets reach maximum intensity at the same place in the spectral sequence (B2).

2. Near maximum the singlets are slightly weaker than the near-by triplets of corresponding spectral series, and there is little change from star to star. No difference has been found in the vicinity of B2 between giants and dwarfs.

3. For the hotter stars the singlets fade out more rapidly than the triplets. This effect is slight for the dwarfs, but extremely large for the giants.

4. In the cooler stars there is little, if any, difference between giants and dwarfs, in so far as the relative intensities of triplets and singlets are concerned.

Since neither the Boltzmann law nor the gradient effect can account for these changes, we are forced to reconsider the assumption of thermodynamic equilibrium.

To test this assumption the writer has investigated the lines of O II, some of which have excitation potentials as low as 22.9 volts, while others have excitation potentials of 28.7 volts. The relative intensities of the lines of high and of low potential in hot and in cool stars were measured and the results show a marked variation with temperature. Assuming thermodynamic equilibrium and Boltzmann's principle we obtain a relation between the temperatures of the hot and the cool stars. The results are in harmony with other determinations of the temperatures of the stars. Evidently the atoms of O II are distributed among the various states in accordance with Boltzmann's principle and conform to the requirements of thermodynamic equilibrium. This seems to be true for doublets as well as for quartets, for giants as well as for dwarfs.

An even better test could probably be made for Si IV. Here $\lambda\lambda$ 4089 and 4116 have excitation potentials of 24.0 volts, while for λ 4212 the excitation potential is 36.0 volts. Since λ 4212 is always much fainter than the other two lines, the turbulence effect is harder to eliminate, and very accurate measurements will be required. Qualitatively, the observations seem to be in accordance with the Boltzmann principle.

Why, then, is He I the only element in which the Boltzmann principle is upset? To answer this question we must first consider three other questions:

1. Is there any independent evidence of departures from thermodynamic equilibrium in stellar atmospheres?

2. Is it possible that our tests of the Boltzmann distribution are not sufficient to prove the existence of thermodynamic equilibrium?

3. What properties of the He I spectrum are likely to produce the observed differences between singlets and triplets?

Question 1 can be answered in the affirmative. Recent studies of such stars as ϵ Aurigae and ζ Aurigae have shown that reversing layers may be comparable in thickness to the diameter of the star. Such an atmos-

phere cannot be considered to be in thermodynamic equilibrium, since the photospheric radiation passes it in one direction only, and since in the upper regions this radiation must be appreciably diluted. In supergiants of classes B and O, the reversing layers have not been measured, but various considerations suggest that they, too, are greatly extended and may be far removed from thermodynamic equilibrium.

It is tempting to strengthen the argument by referring to the well-known phenomenon in late-type stars discovered by Russell and Adams and attributed by them to departures from thermodynamic equilibrium. Although much has been written about this, Russell has recently raised some doubt concerning the observational material upon which the conclusion was based, and more accurate measurements will be required before the phenomenon can be interpreted.

The second question can also be answered in the affirmative. Consider two atomic states. In thermodynamic equilibrium the atoms will be distributed between them in accordance with Boltzmann's law, *i.e.*

$$N_2 = N_1 e^{-\epsilon/kT}$$

where ϵ is the energy of state 2 and T is the temperature. If the gas is not in thermodynamic equilibrium, but is illuminated by diluted radiation corresponding to temperature T, the number of atoms in state 2 is approximately given by

$$N_1 \beta e^{-\epsilon/kT}$$

where $\beta < 1$ is the dilution factor (for thermodynamic equilibrium $\beta = 1$). The distribution of atoms therefore resembles that given by the Boltzmann principle. Accordingly, our result of the distribution of O II atoms in different energy states is a necessary but not a sufficient condition of thermodynamic equilibrium.

We shall try to explain the helium anomaly by assuming that the giants of classes O and B are not in thermodynamic equilibrium. For the dwarfs we shall continue with the usual assumption.

With regard to question 3, there are two features of the He I atom which make it stand out among other atoms and which are suggestive in this problem: He I has almost no intersystem transitions, and the lowest term of the triplet system is metastable. An atom that has found itself in that level can not be removed from it by radiation of energy. It can leave that state only by absorption or by collision.

The metastability of the lowest triplet level is particularly suggestive. Readers will remember that the metastability of certain levels of O III causes the enormous intensity of the "nebulium" lines in novae and in nebulae. Eddington and Rosseland were able to show that in the presence of diluted stellar radiation there must be an enormous accumulation of atoms in the metastable state.

Consider, with Rosseland, states 1, 2, and 3, and let state 2 be metastable. In thermodynamic equilibrium the numbers of atoms in the

three states are given by Boltzmann's principle. But if thermodynamic equilibrium does not exist, there will be an accumulation of atoms in state 2. Woolley has recently extended Rosseland's theory to the case where state 3 is that of ionization. Here, too, the metastability of state 2 will result in an excess of atoms in that state.

Let us apply these considerations to the helium atoms of B-type stars. In the dwarfs the numbers of atoms are all given by Boltzmann's formula. In the giants collisions are rare and the photospheric radiation is diluted. For the cooler stars ionization is unimportant, and we shall have approximately the case

$$N_2 = N_1 \beta e^{-\epsilon/kT}$$

where a Boltzmann distribution is imitated. Since ionizations are rare, collisions are the only means by which atoms can pass between triplet and singlet systems. In so far as collisions are concerned there are no metastable states, and the distribution of atoms between triplets and singlets will be normal.

For the hottest giants, on the other hand, ionization predominates over collisions. Here the metastability of the lowest triplet level becomes important. Atoms begin to accumulate in the triplet system, producing (what is actually observed) a relative weakening of the singlet lines in the hotter giants.

This explanation is not only reasonable but it has the advantage of reconciling the laboratory results with the stellar data. Evidently, in the laboratory experiments recombination was relatively unimportant. It might be of interest to repeat the work of Ornstein and his associates for recombination spectra of He I. According to our theory there should then be no strengthening of the singlet lines when the pressures are reduced.

Abundance of Elements

It is surprising that the spectral classification, devised at Harvard many years ago on the basis of objective-prism plates, was not materially improved after the introduction of modern slit-spectrographs. There can be no doubt that the latter are superior in definition to the objective prisms. However, attempts to refine the classification have usually been failures. Marked improvements have been made only in the classification of the O stars by H. H. Plaskett, in the A and B stars by Adams and Joy, and in the R, N, and S stars by Curtiss, Shane, Merrill and others.

A detailed study of the spectra of B stars has shown that even with the best spectrographic material, subdivided into giants and dwarfs, the smallest step attainable by the use of the Harvard criteria is about one-twentieth of one spectral class. The precision of the estimates or measurements of line-intensities is much greater. Evidently the Harvard criteria become slightly conflicting when the classification is refined more than was originally intended. It is clear that these conflicting re-

sults conceal important data concerning the atmospheres of the stars, and an attempt must be made to study them.

The first step is to obtain a reliable subdivision into giants and dwarfs. Since we intend to study minor changes in the intensities of the absorption lines, we must try to make this separation with the help of independent criteria. Otherwise the variations in the intensities would be taken up in the process of separating the giants from the dwarfs. The following three criteria give useful results: the extent of the hydrogen wings, the intensity of forbidden helium, and the intensity of interstellar calcium. As Russell, Mrs. Gaposchkin, and Menzel have pointed out, these criteria are only moderately reliable. Their use, however, is necessary in order to retain the line-intensities in as pure a state as possible, so that not even the smallest discrepancy should inadvertently be lost.

Let us now consider the dwarfs of type B. If we arrange them in order of increasing intensity of the Mg II line 4481 we obtain a uniform sequence that runs roughly parallel to the Harvard classes. Other lines such as He 4472 will, in general, show a uniform change. But in a few cases we find that the He I line does not fit into the arrangement. Thus in Maia (20 c Tauri) the He I lines are distinctly too weak for the place assigned to this star on the basis of the strength of Mg II 4481. Moving it toward later subdivisions would improve matters with respect to He I, but would make it worse for Mg II.

We are tempted to assign the discrepancy to an effect of absolute magnitude. But the evidence from the giant series shows that pressure can not be responsible for the discrepancy.

A complete discussion of similar conflicting data in the A stars has recently been completed by Morgan. He arranged all stars in a two-dimensional array according to the intensity of CaK and FeII 4233. Stars having identical intensities for these lines were then compared. For example, three stars were found for which Ca K = 2 and Fe II 4233 = 1. These are ι Lib, α And, and β Per. The intensities of the other lines are by no means the same. Thus, all of the stronger He I lines are conspicuous in Algol, while they are weak in α And and ι Lib. Mg II 4481 is considerably stronger in Algol than in the other stars. S II is weak in Algol, is slightly stronger in α And and is very strong in ι Lib. The Mn II lines, which are strong in α And, are absent from Algol. The unidentified line λ 4200 is very strong in ι Lib, weak in α And, and probably absent from Algol. From the greatly differing appearance of these three spectra it is apparent that a two-dimensional scheme is insufficient to represent all observed details. The discrepancies in the A stars are such that no marked improvement in the Draper classification is possible.

Similar results were obtained by Hynek for the F-stars.

The question of the cause of the discrepancies now arises. While this problem has not been solved, it is possible to make a few generalizations:

a). No matter which elements are taken as standards in the two-

dimensional arrays, all other elements show some slight dispersion of intensity.

b). If elements A and B are taken as standards, other lines belonging to A and B or to their ions A^+ and B^+ show only such a dispersion in intensity as can be accounted for by the theory of ionization, the gradient effect, and other phenomena discussed earlier in this paper.

c). There is no great difference in the behavior of giants and dwarfs. By the use of two suitable standards, such as Ca K and Fe II 4233 in the A stars, the major physical parameters, temperature, and pressure ought to be accounted for, so that the remaining dispersion can not be directly attributed to ionization.

While these generalizations are scanty, they suggest that the observed dispersion of intensities may be due to individual differences in the abundances of the elements in different stars.

The abundance problem is not new in astrophysics. H. H. Plaskett and Miss Payne gave relative abundances of different elements in stars of various types but made no attempt to find differences in abundance for different stars. Russell, Plaskett, and Payne have called attention to the general similarity in abundance of all stars, and of the stars in general to the crust of the earth. A complete analysis of the composition of the sun's atmosphere was made by Russell. Differences in hydrogen content have been recognized by Russell. Beals and Miss Payne discussed the relative abundance of carbon and of nitrogen in the Wolf-Rayet stars. According to Russell, differences in the abundance of oxygen and carbon may account for the branching of the spectral sequence in the cooler stars. Öpik has recently estimated that the probable deviations of the individual fluctuations in the relative abundance of calcium in stars of classes F0 to G5 do not exceed 27 per cent for giants and 19 per cent for dwarfs. Finally, Berman has found that, while in the majority of stars hydrogen is by far the most abundant element, the variable R Cor Bor consists mostly of carbon (69%) with only a relatively small admixture of hydrogen (27%) and of metals (4%).

The special cases cited above suggest that the dispersion in the intensities caused by differences in abundance is not the same for all elements, nor is it the same for any single element in all spectral classes. The study of atomic abundance has hardly been started, and it promises to give important results. Slowly and cautiously, from several different sides, we are beginning to attack the problem of stellar composition. Fifty years ago astronomers thought they had solved this problem. Then after the work of Lockyer, Saha, *etc.*, we realized that what we thought were differences in composition were really differences in temperature and density. Let us hope that we are now on firm ground!

In this connection mention may be made of several recent papers and discussions concerning the classification of stellar spectra. Most of the phenomena discussed in the present article deal with minute differences in the intensities or contours of spectral lines, and for these the Henry

Draper classification is not sufficiently refined. For example, in the study of the intensities of O II lines having different excitation potentials an arrangement of the stars according to the Draper class is too coarse. For many studies of this character accurate line intensities must take the place of spectral class. Without a procedure of this sort an investigation such as that of the helium anomaly, of atomic abundance, of turbulence, *etc.*, would be difficult.

It was mentioned above that because of differences in abundance, in gradient, *etc.*, no material refinement of the Draper classification on the basis of the Harvard criteria is feasible. One might reasonably ask whether, in view of our increasing knowledge of stellar spectra, an entirely new system of classification should be invented that would permit greater refinement. For example, such a system could plausibly be based upon accurate intensity measurements of a single spectral line, such as Ca K, over a large range of spectral classes.

In actual practice, such a new classification does not seem desirable. For most statistical investigations the Draper classification is adequate. For at least ninety-nine per cent of all stars, objective-prism material must be used for classification purposes, and for these no improvement would be possible. Finally, it would be undesirable to complicate the literature by the introduction of new systems involving new designations.

Detailed studies of bright stars accessible to spectrographs with high dispersion can always be supplemented by special classifications based upon accurate measurements. The work described in the preceding pages shows that this method is already in operation, and the results are ample justification for it.

These comments on the spectral classification are, on the whole, in agreement with the recent recommendations by Russell, Mrs. Gaposchkin, and Menzel. I should merely wish to suggest tolerance towards temporary working schemes or classifications which alone can bring about progress in the interpretation of stellar spectra. Such schemes are, of course, used in many problems: Miss Payne recommended one for the O stars; Lindblad, Öhman, Schalén, and others have developed a special classification adapted to their own plate material and suitable for their special problems.

Unsolved Problems

In the course of this discussion we have encountered numerous unsolved or partly-solved problems. There are others which have thus far resisted all attempts to solve them.

One of these problems is that of a group of stars which we call spectrum variables. Many years ago Belopolsky discovered that the intensities of the spectral lines in α^2 Can. Ven. undergo regular variations in intensity, with a period of 5.5 days. Detailed investigations have been published by Gerasimovič, Markov, Miss Anger, Miss G. Farnsworth, and others. For a time the star was believed to be a spectroscopic

binary but the evidence is now fairly conclusive that the observed variations in velocity are merely the result of blending with variable absorption lines. The total light of the star is probably slightly variable, according to Guthnick.

In recent years Morgan has found a fairly large group of A and F stars which show similar variations. Other cases have been found by Guthnick. For some of these stars the periods have been determined, in others the variations seem to be irregular. A relationship with Cepheid variables is, of course, suspected, but variability in light is certainly not a conspicuous feature in these stars.

An entirely different type of spectrum variable is the spectroscopic binary μ Sagittarii. Morgan found that near periastron the He I line 4472 is greatly strengthened. The maximum of intensity occurs about nine days after periastron. The period is 180 days and the eccentricity 0.45. The strengthening of the line 4472 may either be related to the turbulence effect or it may have some connection with the helium anomaly. Certain it is that periastron passage has something to do with it.

Other cases of variation in the line-intensities of spectroscopic binaries were discovered by Bailey in μ' Scorpii, by Miss Maury in V Puppis, and by the writer in α Virginis. In all three stars the components vary in intensity, being strongest near minimum velocity and weakest near maximum. An interesting case is that of the Oe star 29 Can. Maj. recently investigated by Struve, Elvey and Morgan. Here the emission lines as well as the absorption lines vary in intensity, but there is a phase-difference between the emission lines and the absorption lines.

Variations in the line intensities were found in many other peculiar stars. Some of these, for example, R Aquarii, have been carefully studied by Merrill. Others, like 27 Can. Maj. are characterized by large amplitudes in the velocity curve, which, however, have now been definitely shown to be inconsistent with orbital motion. McLaughlin and others have made a systematic study of several variable Be stars.

An extraordinary phenomenon was recently investigated by Morgan. In certain giant spectra of late type an unusual and entirely abnormal strengthening of the low-excitation lines of neutral iron was observed. The phenomenon is not in accordance with Boltzmann's principle, nor can it be explained by turbulence. Departures from thermodynamic equilibrium are more probable.

In conclusion, attention may be called to the phenomenon of "interlocking," which has been investigated by Woolley and by Thackeray. "The number of upward transitions between any two states is dependent on the intensity of the incident radiation of the corresponding wavelength. High up in the atmosphere where the radiation is deficient in certain line-frequencies (the deficiency being greatest for strong lines) the number of upward transitions is relatively diminished for strong lines, but the number of downward transitions is determined by constant transition probabilities, and the ratio of such transitions from a given

state for strong and weak lines of a multiplet remains constant. Thus the strong lines have a greater tendency towards self-reversal than the weak lines." Thackeray has found some evidence of interlocking in a multiplet of Fe I observed by him in 30 stars of classes F to M.

YERKES OBSERVATORY, APRIL 29, 1935.

Planet Notes for January, 1936

By CLIFFORD E. SMITH

Note: All times, unless otherwise stated, are Central Standard Time.

The *Sun* will be moving with a northeasterly motion from the central part of Sagittarius to the central part of Capricornus. On January 4 at 4:00 A.M. the earth will be at perihelion, that is, the earth will be nearest the sun in its orbit. At that time the sun's distance from the earth will be about 91.34 million miles. By the end of the month, this distance will be increased by about 160,000 miles. The position of the sun on the first and last days of the month will be, respectively: R.A. $18^h\ 41^m$, Decl. $-23°\ 7'$; and R.A. $20^h\ 50^m$, Decl. $-17°\ 46'$.

The phenomena of the *Moon* will occur as follows:

First Quarter	Jan.	1 at	9 A.M.
Full Moon		8 "	12 NOON
Last Quarter		16 "	2 P.M.
New Moon		24 "	1 A.M.
First Quarter		30 "	6 P.M.
Apogee		14 "	6 P.M.
Perigee		26 "	12 NOON

On January 8 there will be a total eclipse of the moon,[1] "the beginning visible generally in the northeastern part of the Atlantic Ocean, Europe, eastern Africa, Madagascar, Asia, the Indian Ocean, Australia, Polynesia, the western part of the Pacific Ocean, Alaska, northwestern Canada, and the Arctic Ocean; the ending visible generally in the eastern part of the Atlantic Ocean, Europe, Asia, and Africa, the Indian Ocean, Australia, with the exception of the southeastern part, the western part of the Pacific Ocean, northwestern Alaska, and the Arctic Ocean."

Mercury will be an evening object and during the first three weeks of the month will be moving with an apparent easterly motion from eastern Sagittarius to central Capricornus. On January 22 its apparent motion will become retrograde. On January 15 at midnight Mercury will be at greatest elongation east (18° 50′ E). At that time its distance from the earth will be about 95 million miles and its apparent diameter will be about 6.6 seconds of arc. Its position will be R.A. $21^h\ 0^m$, Decl. $-17°\ 48'$. During the middle of the month Mercury will set about an hour and a half after the sun. By the end of the month, however, it will be near the sun in apparent position, since inferior conjunction will occur January 31 at 5:00 P.M. Conjunction with the moon will occur on January 25 at 1:00 A.M. (Mercury 1°.0 S).

Venus will be a morning object moving with an apparent easterly motion from the eastern part of Libra, across northern Scorpio to western Sagittarius.

[1] *American Ephemeris and Nautical Almanac*, 1936, page 560.

During this period it will rise about 3 hours before the sun. The distance from the earth will increase from about 93 million miles to about 112 million miles. The corresponding change in the apparent diameter will be from about 16.8 to about 14.0 seconds of arc. At noon on January 15 Venus will be in conjunction with Jupiter (Venus 1°.4 N). On January 21 at 1:00 A.M., conjunction with the moon will occur (Venus 3°.7 N).

Mars will be an evening object in western Aquarius setting about two and a half hours after the sun. The distance from the earth will be about 190 million miles and the apparent diameter will be about 4.6 seconds of arc. A conjunction with Saturn will occur on January 25 at 10:00 A.M. (Mars 53′ N). A conjunction with the moon will occur on January 26 at 5:00 P.M. (Mars 5°.8 S).

Jupiter will be a morning object in southern Ophiuchus and during the middle of the month will rise about three hours before the sun. Its apparent motion among the stars will be easterly. By the middle of the month its distance from the earth will be about 563 million miles and its polar diameter will be 30.3 seconds of arc. On January 15 at noon a conjunction with Venus will occur (Jupiter 1°.4 S). A conjunction with the moon will occur on January 20 at 3:00 P.M. (Jupiter 3°.0 N).

Saturn will be an evening object in central Aquarius and during the middle of the month will set about three hours after the sun. Its apparent motion in the sky will be easterly. Its distance from the earth during this period will be about 964 million miles and its apparent polar diameter will be about 14.4 seconds of arc. Conjunction with Mars will occur on January 25 at 10:00 A.M. (Saturn 54′ S). On January 26 at 4:00 P.M. conjunction with the moon will occur (Saturn 6°.7 S).

Uranus will be an evening object in southern Aries and during the latter part of the month it will be toward the south at sunset for northern observers, since quadrature east of the sun will occur on January 22 at 1:00 P.M. Its apparent motion will be retrograde until January 10 when it will become direct again. The distance from the earth will be about 1820 million miles and the apparent diameter about 3.5 seconds of arc. Its position on January 15 will be R.A. $1^h\,58^m.3$, Decl. $+11°\,33'$. Uranus will be in conjunction with the moon twice during the month: January 3 at 1:00 A.M. and January 30 at 7:00 A.M. (Uranus 5°.8 S for each occasion).

Neptune will be a morning object in southeastern Leo and during the middle of the month it will be on the meridian (toward the south for northern observers) at about 4:00 A.M., local time. Its distance from the earth will be about 2750 million miles and its apparent diameter will be about 2.5 seconds of arc. Conjunction with the moon will occur at noon on January 13 (Neptune 6°.4 N). Its position on January 15 will be: R.A. $11^h\,12^m.2$, Decl. $+6°\,14'$.

OCCULTATION PREDICTIONS

(Taken from the *American Ephemeris.*)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the

Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.

Date 1936		Star	Mag.	IMMERSION Greenwich C.T. h m	a m	b m	Angle E from N °	EMERSION Greenwich C.T. h m	a m	b m	Angle E from N °
Jan.	3	μ Ari	5.7	23 47.1	—2.1	+0.2	94	0 58.6	—1.4	+1.9	220
	5	104 B.Tau	5.5	3 57.0	—1.5	—0.7	86	5 10.8	—1.1	—1.0	264
	6	315 B.Tau	6.3	7 48.3	—0.2	—1.4	101	8 45.7	0.0	—1.3	271
	7	132 Tau	5.0	4 5.9	—1.8	—0.7	101	5 27.2	—1.6	—1.1	277
	7	412 B.Tau	6.0	8 21.4	—0.5	—1.2	88	9 18.8	+0.2	—1.8	298
	9	209 B.Gem	6.1	10 10.4	..	..	39	10 27.6	..	..	7
	9	d^3 Cnc	6.2	23 16.0	+0.5	+2.0	66	0 2.6	—0.4	—0.2	318
	13	p^3 Leo	6.2	12 21.2	—0.7	—2.0	125	13 28.3	—0.4	—1.9	293
	18	17 G.Lib	6.4	7 36.7	—1.0	+1.8	82	8 35.0	—0.3	—0.5	328
	18	18 G.Lib	6.1	8 12.6	—1.1	+1.4	92	9 19.9	—0.7	—0.3	320
	19	42 Lib	5.1	8 40.8	..	..	37	9 1.6	..	..	2
	28	19 Psc	5.3	1 30.8	—0.3	—2.4	113	2 8.7	—0.1	+1.3	198

OCCULTATIONS VISIBLE IN LONGITUDE +91° 0′, LATITUDE +40° 0′.

Jan.	3	μ Ari	5.7	23 14.3	—1.2	+1.6	73	0 27.7	—1.3	+1.7	236
	5	104 B.Tau	5.5	3 24.5	—2.1	—0.4	95	4 45.0	—1.8	+0.3	246
	6	315 B.Tau	6.3	7 47.7	—0.3	—2.5	131	8 41.2	—0.9	—0.4	241
	7	132 Tau	5.0	3 30.3	—2.0	—0.4	112	4 52.0	—2.1	+0.7	255
	7	412 B.Tau	6.0	8 13.3	—0.7	—1.9	118	9 18.4	—0.7	+1.3	270
	9	209 B.Gem	6.1	9 43.6	—1.3	—1.0	87	10 44.1	—0.1	—2.5	324
	13	p^3 Leo	6.2	12 11.4	—0.9	—2.3	148	13 20.4	—1.1	—1.7	279
	28	19 Psc	5.3	1 25.8	—1.1	—3.1	119	2 0.5	—0.2	+2.5	186

OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′.

Jan.	4	ϵ Ari	4.6	8 26.2	—0.9	—0.2	64	9 26.1	—0.2	—1.5	281
	5	104 B.Tau	5.5	2 25.5	—1.5	+1.4	76	3 44.6	—1.7	+1.3	247
	6	k Tau	5.6	8 8.4	—2.0	+0.4	63	9 12.3	—0.7	—2.6	308
	7	132 Tau	5.0	2 42.2	—1.1	+0.9	99	3 53.1	—1.2	+1.6	253
	9	209 B.Gem	6.1	9 7.7	—1.4	—2.5	144	10 22.5	—2.2	—0.7	268
	14	13 B.Vir	5.8	14 13.6	—1.9	—1.4	107	15 33.7	—1.1	—2.4	318
	19	31 B.Sco	5.4	15 33.7	—3.0	+1.6	53	16 34.6	—1.9	—2.2	332
	28	19 Psc	5.3	0 39.5	—2.2	—0.7	93	1 39.4	—0.7	+2.0	199
	31	μ Ari	5.7	6 50.0	—0.2	—2.3	121	7 36.8	—0.7	+0.6	220

Variable Stars

Monthly Report of the American Association of Variable Star Observers for October, 1935

The twenty-fourth annual meeting of the Association was held at Cambridge on October 19. It really began the evening before when the Bond Astronomical Club acted as host to the Association at its annual meeting and Mr. Charles W. Elmer gave the main address, describing his latest trip to Paris and the recent meeting of the International Astronomical Union. Members gathered from far and near, the most distant being Mr. L. E. Armfield, of Milwaukee, Wisconsin. Mrs. Helen S. Hogg, and Messrs. H. B. Webb, L. E. Armfield, and C. P. Olivier were elected to the Council. Newly elected officers are President, Harlow Shapley,

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

Aug. 0 = J.D. 2428015; Sept. 0 = J.D. 2428046; Oct. 0 = J.D. 2428076.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
V Scl			T Cet			T Cas			R And			U Cas			W Cas		
000339			*001620*			001755			001838			004047a			004958		
039[	13.3	Bl	082	6.1	Lt	075	8.8	Mc	080	9.8	Jo	094	11.0	Vn	051	9.5	Cl
SS Cas			T And			075	8.5	Dl	080	9.4	Hm	RW And			052	9.4	Kn
000451			001726			076	8.5	Dl	083	9.8	Hs	004132			053	9.1	Jo
052	11.2	Cl	053	9.4	Jo	076	8.6	Hf	084	9.4	Md	053	8.4	Jo	054	9.6	So
056	10.9	Hf	053	9.4	Mo	076	8.0	Jo	091	9.7	Md	062	8.5	Jo	056	9.4	Cl
061	10.4	Cl	054	9.3	Sq	076	8.1	Ba	S Tuc			063	8.6	Lt	056	9.9	Hf
062	10.5	Ba	062	9.0	Jo	076	8.4	Mn	*001862*			066	8.7	Hf	057	9.7	Ra
062	10.5	Wa	063	9.0	Hi	078	8.6	Cm	039	12.9	Bl	067	8.8	Lt	058	9.7	Wp
062	10.6	Wp	063	8.6	Lt	078	8.3	Dl	042	13.1	Ht	069	8.8	Jo	061	9.7	Wd
063	10.2	Hk	066	8.8	Sq	080	8.7	Dl	062	13.3	Ht	071	8.8	Wd	061	9.6	Cl
066	10.2	Wa	066	8.7	Hf	080	7.9	Jo	066	13.4	Ht	072	9.0	Lt	061	9.8	Hf
067	10.1	Pb	067	8.7	Lt	081	8.0	Me	S Cet			073	9.0	Es	061	9.9	Me
067	9.8	Cl	068	8.9	Hi	R And			*001909*			073	9.1	B	062	9.6	Jo
067	10.1	Hk	069	9.0	Jo	001838			075	13.9	Wu	074	9.0	Pt	062	9.5	Bu
067	9.5	Mg	069	8.6	Md	045	8.0	Ah	078	13.6	Cm	076	9.3	Lt	062	9.8	Sx
067	9.9	BT	070	8.6	Bu	053	8.4	Kp	T Phe			076	9.4	Jo	063	9.9	Pb
067	10.1	Dh	071	9.0	Wd	053	8.3	Jo	*002546*			076	8.9	Hf	063	9.9	Dh
069	9.7	Ba	072	8.5	B	054	8.3	Sq	039[	13.6	Bl	079	9.2	Cm	066	9.9	Hf
069	10.1	Rb	072	8.5	Lt	056	8.5	Ah	051[	13.0	Ht	080	9.6	Jo	067	9.6	Cl
071	9.2	Jo	073	8.8	Es	058	8.1	Me	066	13.1	Ht	V And			067	10.3	Gy
073	9.3	Es	074	8.5	Cl	061	8.4	Bu	W Scl			004435			067	10.1	Dh
074	9.2	Cl	074	8.7	Pt	062	8.7	Ah	*002833*			066	9.9	Hf	068	10.1	Pb
076	9.4	Jo	075	8.8	Md	062	8.5	Jo	039	13.0	Bl	076	10.0	Hf	068	9.9	Dh
076	9.6	Ba	076	8.9	Hf	063	8.8	Cx	U Cas			079	10.1	Cm	069	10.0	Wd
076	9.7	Hk	076	9.1	Jo	065	9.2	Je	004047a			X Scl			069	10.3	Pb
078	9.8	Cm	076	8.4	Lt	066	8.9	Kp	052	8.5	Kn	*004435*			069	9.7	Jo
079	10.0	Wa	079	9.2	Cm	066	8.6	Sq	053	8.7	Jo	039	11.9	Bl	069	10.1	Gy
079	10.0	Wp	080	9.4	Jo	066	8.9	Ah	058	9.1	Me	RR And			070	10.3	Wp
080	9.6	Jo	081	9.0	Me	066	9.2	Cm	061	9.4	Wd	004533			070	9.7	Bu
083	10.1	Gy	082	8.8	Md	066	9.2	Hb	062	9.5	Jo	069	12.6	Wu	073	9.8	B
083	9.6	Es	082	8.5	Lt	067	9.0	Mg	062	8.8	Sx	075	13.1	Wu	073	9.7	Cl
085	9.7	Es	083	8.4	Gy	067	8.5	BT	063	9.1	Hi	079	13.5	Cm	074	10.3	Dh
094	10.4	Es	091	9.0	Md	068	9.6	Cr	063	9.3	Sf	RV Cas			076	10.0	Hf
095	10.5	Es	T Cas			068	9.6	Dl	063	8.6	Lt	004746a			076	10.4	Dh
S Scl			001755			069	8.7	Sh	065	9.0	Pf	052	9.6	Kn	076	9.9	Jo
001032			052	9.3	Kn	069	9.0	Sz	066	9.3	Hf	053	9.6	Jo	077	10.3	Ra
038	10.9	Kd	053	9.2	Jo	069	9.2	Md	066	8.9	Hm	062	9.8	Jo	078	10.2	Cm
039	10.7	Bl	054	9.0	So	069	9.3	Ca	067	8.8	Lt	063	10.1	Sf	078	9.6	Pt
042	11.0	Ht	061	8.8	Wd	069	8.8	Hf	068	9.5	Hi	065	10.0	Pf	U Tuc		
046	10.8	dK	061	9.3	Sx	069	8.9	Jo	069	9.7	Jo	066	10.5	Hf	*005475*		
051	10.1	Ht	062	8.6	Bu	070	8.7	Bu	069	9.6	Bu	071	10.3	Jo	990	8.5	Sl
055	9.5	dK	062	8.8	Hf	070	9.0	Hm	070	9.5	Hm	073	10.7	B	036	9.7	Sl
062	9.3	Ht	062	8.6	Jo	070	8.9	Ah	070	9.0	Pf	074	11.2	Pt	039	9.9	Bl
063	9.0	dK	062	8.6	Ba	071	9.2	Wd	072	9.7	B	076	10.9	Jo	042	10.1	Ht
066	8.9	Ht	062	8.5	Sq	072	9.3	Ac	072	9.4	Lt	076	10.8	Hf	051	10.8	Ht
071	8.1	dK	063	8.7	Mc	072	9.1	B	075	9.4	Hm	078	11.1	Cm	062	11.7	Ht
X And			068	8.5	Dl	074	8.5	Pt	076	9.5	Hm	— Cas			066	12.0	Ht
001046			068	8.6	Mn	074	9.0	Ah	076	9.9	Hf	004746b			Z Cet		
070	14.2	Pf	069	8.4	Jo	074	9.1	Cl	076	9.8	Jo	052	10.8	Kn	*010102*		
073	13.8	B	069	9.0	Wd	075	9.3	Kp	078	9.7	Cm	053	10.5	Jo	074[	12.1	Cl
T Cet			069	9.0	Sh	075	9.1	Dl	078	9.5	Hm	056	10.8	Hf	U Scl		
001620			069	8.2	Ba	075	9.1	Hm	080	9.9	Hm	065	10.6	Pf	*010630*		
038	5.9	Kd	070	8.4	Ah	076	9.6	Jo	080	10.0	Jo	066	10.7	Hf	039[	13.2	Bl
065	6.0	Lt	072	8.0	B	078	9.5	Dl	082	10.3	Me	071	10.8	Jo	U And		
066	5.7	SK	073	8.6	Bu	078	9.3	Hm	081	10.8	Vn	076	10.7	Jo	010940		
071	6.0	Lt	074	8.3	Ah	079	9.2	Cm	090	11.3	Vn	076	10.7	Hf	066	11.7	Jo
078	6.1	Lt	074	8.2	Pt							078	10.6	Cm	069	11.8	Jo

Variable Star Observations Received During October, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
U And			Y And			RV And			W And			o Cet			S Per		
010940			013338			020448			021143a			*021403*			021558		
069	10.7	Rl	066	8.8	Hf	063	9.5	H	062	8.7	Jo	067	9.2	Dh	076	9.0	Hm
070	11.1	B	066	9.5	Jo	066	9.7	Jo	066	8.7	Jo	067	9.1	Ku	076	9.2	Hf
071	11.4	Jo	069	9.2	Jo	066	9.4	Hf	066	8.5	Hf	067	9.0	Pb	076	9.0	Jo
075	10.8	Jo	069	9.0	Md	067	9.6	Hk	069	8.5	Jo	068	9.3	Pb	076	9.1	Dh
079	10.5	Cm	075	9.3	Jo	069	9.4	Hk	074	8.2	Ah	068	9.3	Dh	076	9.1	Pb
080	10.6	Jo	076	8.9	Hf	069	9.5	Rb	076	8.2	Hf	069	9.2	Hb	078	9.4	Dl
UZ And			077	9.0	Me	070	9.4	Wp	076	9.0	Me	069	9.3	Ah	078	8.6	Pt
011041			078	8.6	Pt	071	9.5	Wd	076	7.8	Jo	070	9.1	Hm	078	9.2	Hm
067	[13.9	Pf	079	9.5	Cm	075	9.7	Jo	078	7.6	Pt	071	8.8	dK	080	9.2	Hm
074	[14.5	Wu	080	9.0	Jo	076	9.3	Ba	079	8.5	Cm	071	9.3	Dl	080	9.3	Dl
079	[13.6	Cm	082	8.9	Md	076	9.6	Hk	083	7.5	Gy	071	9.2	Jo	082	9.3	Me
S Cas			084	9.1	Md	076	9.7	Hf	T Per			074	9.2	Ah	083	9.2	Gy
011272			091	9.2	Md	076	10.0	Rb	021258			074	9.2	Pb	085	9.3	Cm
053	12.3	Jo	X Cas			078	9.6	Wa	053	8.6	Jo	074	9.2	Dh	086	9.3	Dl
056	11.6	Mo	014958			078	9.7	Wp	064	9.1	Wd	075	9.3	Hm	089	9.1	Kg
070	12.5	B	066	12.3	Jo	078	9.6	B	065	8.7	Cm	075	9.3	Dl	R Cet		
078	12.4	Cm	069	12.4	Jo	078	9.8	Me	065	9.1	Lt	076	9.2	Dh	*022000*		
078	12.4	Pt	076	12.2	Jo	079	9.8	Cm	065	8.6	Bu	076	9.0	Hf	022	8.0	Kd
090	[11.4	Vn	077	13.0	Me	080	9.4	B	066	9.2	Hm	076	9.0	Bu	066	11.1	Mo
U Psc			078	13.3	Pt	R Ari			066	9.0	Hf	076	9.3	Dl	RR Per		
011712			078	12.9	Cm	021024			066	8.7	Kn	078	9.0	Dl	022150		
078	[12.8	Pt	078	12.5	B	037	8.1	Ah	068	9.1	Dl	080	9.1	Dl	078	[13.2	Pt
R Scl			U Per			045	8.2	Ah	069	9.0	Wd	080	8.5	Rb	085	13.2	Cm
012233a			015254			052	8.8	Jo	069	8.5	Hb	081	8.9	Me	094	[13.5	Es
038	8.5	Kd	049	9.9	Ry	056	8.2	Ah	070	9.1	Hm	083	9.0	Hs	R For		
RZ Per			053	9.9	Ry	056	8.8	Hf	071	8.5	Jo	S Per			*022426*		
012350			053	9.6	Jo	062	8.6	Ah	073	8.7	Kb	021558			039	9.6	Bl
052	10.0	Kn	056	10.1	Hf	062	8.8	Jo	074	9.1	Lt	050	8.6	Mo	066	10.5	Jo
053	9.6	Jo	056	10.0	Ry	063	8.6	Dh	075	9.1	Hm	053	8.8	Jo	075	10.5	Jo
066	10.0	Hf	061	10.1	Ry	063	8.8	Bu	075	9.0	Dl	063	9.1	Pb	U Cet		
066	9.5	Jo	062	10.3	Ba	063	8.6	Pb	075	8.7	Bu	063	9.1	Dh	*022813*		
071	9.7	Jo	062	10.3	Jo	064	8.6	Ah	076	8.7	Jo	064	8.4	Kg	063	8.2	Lt
076	9.7	Jo	064	10.5	Kn	066	9.0	Hf	076	9.0	Hf	064	9.0	Wd	066	7.5	Jo
076	9.8	Hf	065	10.1	Ry	066	9.0	Jo	076	9.0	Hm	064	8.6	Bu	066	8.3	Hm
083	9.6	Gy	065	10.5	Cm	067	9.0	Dh	078	9.1	Hm	065	8.6	Bu	067	7.7	Lt
085	10.3	Cm	066	10.7	Hf	068	9.1	Dh	078	9.2	Dl	065	9.0	Cm	069	7.7	Hb
R Psc			069	10.6	Jo	068	9.1	Pb	078	8.8	Pt	065	9.1	Dh	071	7.4	Lt
012502			069	10.1	Ba	069	9.7	Pb	080	9.2	Dl	066	8.7	Kn	075	6.9	Lt
037	9.3	Ah	074	10.8	Ry	070	9.8	Pb	080	9.2	Hm	066	9.2	Hf	075	8.5	Hm
056	10.1	Hf	075	10.8	Ry	070	8.8	Ah	085	9.0	Cm	066	9.4	Hm	076	7.0	Hf
064	10.3	Ah	075	10.4	Ba	071	9.4	Wd	086	8.8	Dl	067	9.1	Pb	076	7.4	Me
066	10.8	Hf	076	10.8	Hf	073	9.8	Pb	Z Cep			067	9.1	Dh	078	7.1	Pt
066	10.3	Jo	076	11.0	Jo	074	9.2	Ah	021281			068	9.1	Pb	078	6.7	Cm
069	10.8	Gy	078	10.2	Pt	074	9.6	Dh	078	[12.5	Pt	068	9.2	Dl	079	6.9	Lt
076	11.2	Hf	083	10.8	Cm	074	9.6	Pb	o Cet			068	9.1	Dh	080	8.0	Hm
078	11.4	Pt	085	10.9	Cm	075	9.4	Bu	*021403*			069	9.0	Sz	086	6.7	Lt
083	11.6	Gy	XX Per			076	9.8	Dh	037	9.3	Ah	069	9.3	Fs	RR Cep		
RU And			015654			076	10.2	Jo	046	9.2	dK	069	9.1	Wd	022980		
013238			063	8.4	Lt	076	9.8	Pb	053	9.0	Jo	069	9.3	Pb	078	[12.9	Pt
056	11.8	Hf	072	8.4	Lt	076	9.3	Hf	055	9.0	dK	069	8.4	Hb	R Tri		
077	12.8	B	S Ari			078	9.4	Pt	056	9.2	Hf	070	9.2	Hm	023133		
077	12.8	Me	015912			080	10.1	Cr	063	9.4	Ah	071	9.0	Jo	037	10.8	Kd
078	12.8	Pt	070	[13.7	Wp	085	9.7	Cm	065	9.1	Fn	073	9.2	Kg	038	10.8	Kd
079	12.4	Cm	078	[14.3	Wa	W And			065	9.2	Bu	074	9.3	Dh	056	9.7	Hf
Y And			083	[12.0	Gy	021143a			065	8.9	dK	075	8.6	Bu	064	9.5	Ah
013338			RV And			052	9.7	Kn	066	9.3	Hm	075	9.2	Dl	064	9.5	Bu
053	11.2	Jo	020448			053	9.7	Jo	066	9.2	Hf	075	9.2	Hm	065	9.6	Je
056	9.9	Hf	062	9.5	Ba	056	9.4	Hf	066	9.2	Jo				066	9.5	Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R TRI			T ARI			W PER			Y PER			U CAM			W TAU		
023133			024217			024356			032043			033362			042215		
066	9.4	Hf	071	9.4	Hu	076	10.0	Dh	063	8.8	Mc	066	8.1	Hm	074	11.3	Dh
066	9.4	Jo	071	9.6	Me	076	9.7	Bu	064	8.4	Hv	067	8.3	Hm	075	11.0	Pt
066	8.7	Hm	071	9.5	Jo	076	10.0	Hm	064	8.4	Hv	067	8.2	Kn	076	11.2	Pb
067	9.5	Dh	076	9.1	Jo	078	10.0	Hm	064	8.2	Bu	068	8.2	Hm	076	11.1	Dh
067	9.5	Pb	076	9.7	Hf	080	10.1	Hm	065	8.1	Bu	068	7.8	Bu	076	11.2	Hk
068	9.4	Pb	083	9.3	Me	083	9.2	Pt	065	8.5	Hv	070	8.4	Hm	080	11.0	Jo
068	8.8	Dl	W PER			086	9.2	Es	066	8.7	Mc	071	7.8	Jo	S TAU		
068	9.4	Dh	024356			094	9.5	Es	066	8.9	Ah	075	8.4	Hm	042309		
068	9.5	Je	049	9.7	Ry	R HOR			067	8.8	Wd	076	8.6	Hm	058	10.7	Mo
069	9.5	Hb	052	9.9	Kn	*025050*			067	8.8	Hf	076	8.5	Hf	066	11.3	Mo
070	9.2	Ah	053	9.6	Ry	990	10.7	Sl	067	8.6	Hv	076	7.9	Jo	066	11.4	Cm
071	9.4	Wd	053	9.3	Hv	039	6.7	Bl	068	8.5	Hv	077	8.2	Bu	066	11.7	Jo
073	9.5	Bu	053	9.7	Jo	042	6.8	Ht	070	8.9	Ah	078	8.1	Wa	067	11.7	Dh
073	9.0	Kg	053	9.3	Bc	046	6.8	dK	070	8.1	Bc	078	8.2	Wp	068	11.7	Pb
074	9.3	Pb	055	9.4	Hv	055	6.4	dK	071	8.4	Jo	078	8.7	Dl	070	11.6	Cm
074	9.1	Ah	056	9.5	Hv	064	5.1	Ht	074	8.9	Ah	078	8.3	Hm	075	11.8	Pt
074	9.3	Dh	056	9.6	Ry	065	6.4	dK	075	8.8	Mc	080	8.5	Hm	076	11.5	Hf
075	9.1	Dl	057	9.4	Hv	071	6.3	dK	076	8.3	Bu	080	8.0	Jo	077	11.1	Me
075	8.6	Hm	061	9.7	Ry	T HOR			076	8.5	Jo	083	8.5	Wa	080	11.5	Jo
076	9.1	Pb	061	9.1	Me	*025751*			083	8.0	Pt	083	8.6	Wp	083	11.7	Gy
076	9.2	Hf	062	9.4	Jo	990	11.6	Sl	R PER			083	8.7	Hs	T GEM		
076	9.0	Jo	063	9.3	Hv	039	9.4	Bl	032335			U ERI			043065		
076	9.1	Dh	063	10.0	Mc	042	9.4	Ht	066	12.0	Jo	*034625*			053	8.9	Jo
078	8.6	Pt	063	10.2	Pb	046	9.0	dK	069	11.8	Jo	058	10.0	Mo	056	8.9	Hf
080	8.6	Hm	063	10.2	Dh	055	8.6	dK	075	11.3	Jo	066	10.2	Mo	066	8.7	Hf
083	8.2	Me	064	9.3	Hv	064	8.9	Ht	076	11.3	Me	X PER			066	8.8	Jo
083	8.6	Gy	064	9.4	Bu	065	9.2	dK	076	11.1	Rb	034930			066	8.6	Hm
085	8.3	Cm	065	9.3	Hv	071	8.5	dK	076	10.9	Hf	057	6.3	Lt	067	8.7	Kn
TX PER			065	9.5	Ry	U ARI			083	10.4	Pt	065	6.3	Lt	068	8.6	Bu
024136			065	10.0	Dh	030514			RU PER			066	6.6	Mc	070	8.7	Hm
038	10.8	Kd	065	9.5	Bu	056	9.7	Hf	032339			067	6.4	Mc	071	9.2	Dl
039	10.8	Kd	066	10.0	Mc	066	10.0	Hf	056	11.5	Hf	073	6.4	Mc	071	8.8	Jo
056	10.9	Hf	066	9.8	Hf	066	9.6	Jo	066	11.4	Jo	074	6.3	Lt	075	8.9	Dl
062	10.7	Wn	066	9.4	Jo	069	10.0	Gy	067	11.9	Hk	075	6.3	Mc	075	9.1	Pt
062	10.7	Wa	066	10.4	Hm	076	10.4	Hf	069	12.0	Hk	086	6.4	Lt	075	8.7	Hm
063	10.8	Hk	067	9.1	Ku	083	10.7	Gy	071	11.2	Jo	T ERI			076	8.8	Dl
066	10.7	Ba	067	9.3	Hv	X CET			076	11.0	Jo	*035124*			076	8.8	Hf
066	10.8	Hf	067	10.0	Pb	*031401*			076	11.6	Me	066	12.3	Mo	076	8.6	Jo
067	10.7	Hk	067	9.2	Dh	066	10.0	Jo	076	11.5	Hf	R TAU			077	8.6	Bu
069	10.7	Hk	067	10.3	Hm	067	9.8	Dh	076	12.0	Hk	042209			078	8.9	Dl
069	10.8	Pb	068	9.3	Hv	071	9.7	Me	083	11.5	Wp	066	12.2	Mo	078	8.5	Hm
076	10.6	Hf	068	10.0	Dl	071	9.9	Hu	083	11.4	Wa	070	13.5	Cm	080	8.9	Dl
076	10.8	Ba	068	9.8	Pb	075	9.1	Jo	Nov PER			077	12.9	Me	080	8.7	Jo
076	10.6	Hk	068	9.9	Dh	076	9.7	Hf	032443			083	12.0	Gy	083	8.9	Hs
079	10.8	Wp	069	9.3	Hv	076	9.2	Hk	067	13.6	Ar	W TAU			RX TAU		
079	10.7	Wa	070	9.3	Bc	083	9.1	Gy	068	13.8	Ar	042215			043208		
083	10.8	Gy	070	10.1	Hm	Y PER			069	13.8	Ar	066	11.0	Jo	075	12.8	Pt
085	10.4	Cm	073	9.4	Es	032043			070	13.7	Ar	067	11.2	Dh	R RET		
T ARI			074	9.5	Ry	050	9.1	Mo	073	13.5	Ar	067	11.1	Hk	*043263*		
024217			074	10.0	Dh	053	8.2	Hv	074	13.4	Ar	068	11.3	Dh	990	10.9	Sl
053	9.7	Jo	075	9.4	Hv	053	8.8	Jo	075	13.3	Ar	068	11.2	Pb	039	7.6	Bl
056	10.2	Hf	075	9.8	Mc	053	8.1	Bc	U CAM			069	11.4	Pb	064	7.8	Ht
066	9.8	Hf	075	9.5	Ry	056	8.6	Hv	033362			069	11.2	Dh	X CAM		
066	9.5	Jo	075	10.0	Hm	056	8.8	Ah	056	8.3	Hf	070	11.4	Pb	043274		
067	9.5	Bu	076	9.3	Hv	056	8.9	Hf	061	8.4	Wa	071	10.8	Jo	062	14.2	Wa
069	9.6	Pb	076	10.0	Pb	062	8.5	Jo	061	8.6	Wp	071	11.0	Me	074	12.5	Cl
069	9.6	Hk	076	9.8	Hf	063	8.3	Hv	066	8.3	Hf	071	10.8	Hu	075	12.6	Pt
070	9.8	Pb	076	9.3	Jo	063	8.8	Mc	066	7.7	Jo	073	11.3	Pb			

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R DOR			R AUR			RR CAM			AN ORI			U ARI			V CAM		
043562			050953			052372			*053005t*			053531			054974		
990	5.3	Sl	069	8.5	Sz	062	9.7	Wa	073	11.5	Ar	067	8.7	Lt	069[	12.7	Gy
039	6.1	Bl	069	8.4	Ah	066	9.9	Wa	073	11.5	Hk	072	9.1	Lt	075[	12.7	Pt
064	5.9	Ht	069	8.6	Pb	066	9.7	Jo	S CAM			075	8.6	Pt	Z AUR		
R CAE			070	8.6	Pb	068	9.8	Bu	053068			076	8.8	Jo	055353		
043738			071	8.2	Jo	071	9.6	Jo	053	9.0	Jo	080	8.9	Jo	053	10.4	Jo
039[	11.7	Bl	073	8.9	Pb	076	9.7	Jo	065	10.0	Md	SU TAU			066	10.0	Jo
064[	12.0	Ht	074	8.6	Ah	079	9.8	Wa	066	10.1	Hf	054319			066	9.8	Mc
R PIC			075	8.5	Pt	079	9.9	Wp	066	9.2	Jo	042	14.7	Ar	067	10.0	Hk
044349			076	8.4	Jo	083	10.0	Gy	067	9.9	Hk	043	14.5	Ar	069	9.8	Gy
039	7.2	Bl	076	8.6	Bu	S ORI			068	9.8	Bu	052[	12.8	Gy	075	10.0	Pt
064	8.0	Ht	076	8.9	Hf	*052404*			069	9.8	Kn	054[	13.3	Bj	075	9.8	Mc
V TAU			T PIC			066	10.2	Cm	069	10.3	Gy	056[	12.2	Pt	075	10.0	Jo
044617			*051247*			067	10.1	Dh	071	9.5	Jo	067	14.4	Ar	078	9.8	Bu
075[	12.4	Pt	045	8.8	dK	071	10.0	Hu	072	10.1	Md	068	14.4	Ar	080	10.2	Jo
083[	12.4	Gy	055	9.0	dK	071	10.1	Dl	076	10.1	Md	069	14.3	Ar	083	10.1	Gy
AB AUR			061	9.1	dK	071	9.8	Me	076	10.2	Hf	070	14.2	Ar	RS AUR		
044930			064	9.2	Ht	075	9.7	Pt	076	9.6	Jo	071[	13.0	Hu	055646a		
066	6.9	Lt	071	9.6	dK	076	10.0	Jo	077	10.2	Bu	073	13.7	Ar	067	10.4	Cm
079	6.9	Lt	Nov TAU			080	10.3	Dl	078	10.2	Me	074	13.7	Ar	067	10.4	Hk
R ORI			051316			080	9.9	Jo	083	10.0	Gy	075	12.5	Pt	068	10.7	Dh
045307			067	14.8	Ar	083	9.3	Gy	095	10.0	Md	075	13.7	Ar	068	10.7	Pb
066	12.4	Cm	068	14.8	Ar	T ORI			RR TAU			076	13.2	Me	069	10.6	Hk
R LEP			069	14.7	Ar	*053005a*			053326			081	12.1	Pt	074	10.7	Dh
045514			070	14.6	Ar	038	10.1	Cm	018	11.0	Ry	083	11.9	Gy	075	10.4	Pt
990	6.4	Sl	073	14.5	Ar	042	10.0	Ar	038	11.9	Cm	S COL			076	10.6	Dh
071	8.6	Dl	074	14.2	Ar	042	9.8	Hk	042	12.3	Ar	*054331*			076	10.6	Hk
071	6.8	Jo	T COL			043	9.8	Hk	042	11.6	Ry	064[	12.6	Ht	R OCT		
075	7.0	Jo	*051533*			043	9.8	Dh	043	11.7	Ar	Z TAU			*055686*		
075	6.8	Pt	064	11.7	Ht	046	10.3	Dh	043	10.9	Cm	054615a			030[	12.0	Bl
080	8.5	Dl	S AUR			052	11.3	Jo	044	11.4	Ry	069	10.5	Gy	064[	12.2	Ht
080	7.0	Jo	052034			054	11.3	Bj	047	11.9	Ry	070	10.9	Cm	X AUR		
083	8.1	Gy	053	9.9	Jo	056	10.7	Pt	050	12.1	Ry	083	10.4	Gy	060450		
V ORI			066	9.7	Jo	066	10.2	Cm	052	12.0	Gy	RS TAU			069	9.1	Sz
050003			068	10.1	Dl	067	10.0	Ar	054	11.9	Ry	054615b			075	9.1	Pt
066	11.8	Mo	068	10.7	Pb	068	10.0	Ar	055	11.9	Ry	070	9.3	Cm	V AUR		
066	11.3	Cm	068	10.7	Dh	069	10.0	Ar	056	11.6	Ry	RU TAU			061647		
075	11.5	Pt	069	10.7	Gy	070	11.2	Ar	067	11.4	Ar	054615c			067	11.9	Hk
T LEP			071	10.4	Dl	071	11.0	Hu	068	11.4	Ar	069[	10.5	Hk	068	12.0	Mo
050022			075	10.5	Dl	071	10.9	Me	069	11.3	Gy	070[	13.5	Cm	069	12.0	Gy
075	10.8	Jo	075	9.8	Jo	073	10.3	Ar	069	11.4	Ar	R COL			083	12.2	Gy
075	12.5	Pt	075	8.9	Pt	073	10.4	Hk	070	11.2	Ar	*054629*			V MON		
S PIC			076	10.4	Hf	075	10.5	Pt	070	11.5	Cm	064[	12.4	Ht	*061702*		
050848			076	10.0	Hk	075	10.8	Jo	071	11.0	Hu	α ORI			067[	11.3	Hk
045	8.8	dK	080	9.9	Jo	076	10.3	Me	071	10.8	Me	054907			075	12.2	Pt
055	8.5	dK	083	10.1	Gy	080	10.7	Jo	072	10.6	Me	990	1.1	Sl	UU AUR		
061	8.2	dK	W AUR			081	9.9	Pt	074	10.8	Ry	067	1.0	Lt	062938		
064	8.8	Ht	052036			AN ORI			075	10.8	Ry	074	1.1	Lt	066	5.8	Lt
071	8.1	dK	066	9.9	Jo	*053005t*			076	10.6	Me	U ORI			078	5.7	Lt
R AUR			067	10.2	Cm	038	11.3	Cm	077	10.5	Me	054920a			R MON		
050953			068	9.7	Mo	042	11.6	Ar	083	10.4	Gy	067	11.5	Dh	063308		
053	7.9	Jo	071	9.6	Lt	042	11.5	Hk	RU AUR			067	11.4	Hk	067	12.4	Ar
056	8.1	Hf	075	9.4	Pt	043	11.6	Hk	053337			075	11.6	Pt	Nov PIC		
065	8.2	Bu	075	9.5	Jo	043	11.6	Dh	067	9.9	Dh	076	10.6	Jo	063462		
066	8.0	Jo	076	9.3	Hf	066	11.5	Cm	067	9.8	Hk	080	10.4	Jo	064	9.0	Ht
066	8.4	Hf	080	9.4	Jo	067	11.8	Ar	075	10.0	Pt	083	11.0	Gy	S LYN		
067	8.7	Cm	RR CAM			068	11.8	Ar	U AUR						063558		
068	8.0	Pb	052372			069	11.9	Ar	053531						047	9.9	Ry
068	8.7	Dh	062	9.5	Wp	070	11.9	Ar	056	8.7	Hf				053	9.8	Ry

Variable Star Observations Received During October, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
S Lyn			S CMi			X UMa			1 Car			R UMa			V Hya		
063558			072708			083350			*094262*			103769			*104620*		
071	10.4	Ry	079	11.6	Cm	071	13.6	Cm	978	3.6	En	062	7.4	Ba	030	6.6	Bl
075	10.5	Ry	T CMi			S Hya			979	3.6	En	062	7.2	Ah	RS Hya		
X Gem			072811			084803			980	3.5	En	062	7.0	Wd	*104628*		
064030			067	11.0	Hk	081	8.0	Pt	981	3.9	En	062	7.6	Hm	030[	11.5	Bl
070	10.8	Cm	068	11.0	Mo	T Cnc			983	4.0	En	062	7.2	Rb	RY Car		
Y Mon			075	11.5	Pt	085120			985	4.1	En	062	7.6	Jo	*111561*		
065111			S Vol			075	8.8	Lt	987	3.9	En	064	7.3	Ah	030[	13.1	Bl
075[	13.4	Pt	*073173*			081	7.9	Pt	989	4.1	En	065	7.6	Hm	041[	13.1	Ht
SW Gem			030	11.9	Bl	V UMa			003	4.0	Df	066	7.6	Hs	RS Cen		
065326			042	11.6	Bl	090151			006	3.9	Df	066	7.2	Mc	*111661*		
067	8.9	Hk	064	10.1	Ht	053	10.9	Jo	010	3.2	Df	066	7.0	So	030	9.7	Bl
070	9.1	Cm	U CMi			067	10.2	Mc	Z Vel			066	7.6	Cm	041	11.1	Ht
075	8.7	Pt	073508			067	10.5	Hk	*094953*			066	7.5	Hm	042	11.1	Bl
080	9.3	Jo	075	11.9	Pt	071	10.4	Cm	985	8.5	Sl	067	7.6	Hm	051[	12.1	Ht
R Lyn			Y Gem			075	10.6	Jo	030	10.1	Bl	067	7.3	Mc	X Cen		
065355			073520			080	10.6	Jo	035	10.5	Sl	067	7.4	Kn	*114441*		
067	10.0	Hk	070	10.2	Cm	W Cnc			042	10.4	Bl	068	7.4	Dl	030[	12.2	Bl
069	10.0	Ah	S Gem			090425			045	11.2	dK	068	7.1	Mn	041	12.2	Ht
074	10.1	Ah	073723			074	8.1	Lt	055[	11.2	dK	069	7.2	Sz	AD Cen		
RS Gem			070	9.1	Cm	RW Car			RY Car			069	7.1	Ba	*114858*		
065530			075	9.0	Jo	*091868*			*095563*			069	7.4	Fs	041	9.4	Ht
067	11.0	Hk	075	9.1	Pt	030	9.8	Bl	030[	13.1	Bl	069	7.7	Pb	051	9.4	Ht
068	11.9	Mo	T Gem			041	9.6	Ht	S Car			069	7.0	Gy	062	9.4	Ht
070	10.7	Cm	074323			042	9.7	Bl	*100661*			070	7.3	Ah	066	9.5	Ht
V CMi			070	8.5	Cm	051	9.4	Ht	030	6.1	Bl	070	7.5	Hm	W Cen		
070109			075	8.7	Jo	Y Vel			036	5.4	Sl	071	7.5	Td	*115058*		
075	9.6	Jo	075	8.0	Pt	*092551*			041	6.0	Ht	071	7.4	Wd	030	9.3	Bl
075	9.6	Pt	RZ UMa			030	10.1	Bl	042	5.5	Bl	071	6.3	Cm	041	8.3	Ht
080	9.5	Jo	080165			042	10.6	Bl	050	6.0	Ht	071	7.1	Hf	042	8.2	Bl
R Gem			062	8.7	Md	045	11.0	dK	055	6.0	dK	071	7.0	Jo	046	8.3	dK
070122a			063	8.8	Hk	055[	11.0	dK	061	6.1	dK	073	7.3	Mc	051	8.4	Ht
070	13.3	Cm	067	8.9	Hk	R Car			071	6.5	dK	074	7.0	So	055	7.9	dK
075[	13.0	Pt	069	8.8	Hk	*092962*			U UMa			074	7.0	Ah	062	8.5	Ht
TW Gem			069	8.7	Pb	989	9.0	Sl	100860			074	7.5	Bu	063	8.3	dK
070122c			071	8.9	Cm	026	7.8	Ss	063	6.4	Lt	075	7.5	Hm	066	8.8	Ht
067	8.2	Lt	074	9.1	Md	030	7.0	Ss	068	6.6	Mn	075	7.4	Ba	Z UMa		
074	8.2	Lt	076	9.0	Hk	030	7.5	Bl	074	6.5	Lt	075	7.7	Td	115158		
R CMi			094	8.8	Md	035	6.8	Sl	076	6.6	Mn	075	7.5	Mc	053	6.8	Kp
070310			095	9.2	Md	040	6.8	Ss	082	6.4	Lt	075	7.0	So	061	7.1	Hf
067	10.6	Dh	R Cnc			042	6.7	Bl	Z Car			075	7.4	Dl	062	7.3	Gy
067	10.7	Hk	081112			045	6.9	dK	*101058a*			076	7.7	Td	062	7.1	Bu
075	9.5	Pt	075	9.7	Pt	055	6.6	dK	030[	11.8	Bl	076	7.4	Dl	062	7.4	Kp
075	10.4	Jo	T Lyn			061	6.0	dK	W Vel			076	7.4	Mn	062	6.9	Kn
080	10.2	Jo	081633			071	5.8	dK	*101153*			076	7.7	Hm	062	6.9	Rb
R Vol			067	11.2	Hk	R LMi			030	9.4	Bl	077	7.6	Fl	066	7.0	Rb
070772			RT Hya			093934			042	9.3	Bl	078	7.5	Dl	066	7.4	Kp
064[	12.6	Ht	*082405*			081	8.6	Pt	R UMa			078	7.8	Hm	066	7.5	Hf
L_2 Pup			075	8.0	Lt	R Leo			103769			079	7.5	Mc	067	7.3	Gy
071044			R Cha			094211			037	7.7	Ah	080	7.5	Hs	067	7.1	Bu
989	4.4	Sl	*082476*			071	7.9	Dl	045	7.2	Ah	080	7.5	Cr	068	7.4	Rb
V Gem			989	8.2	Sl	080	8.2	Dl	049	7.8	Pb	080	7.5	Dl	069	7.0	Rb
071713			030	10.9	Bl	081	6.5	Pt	052	7.0	So	080	7.2	Jo	071	7.8	Rb
074	8.5	Lt	036	11.5	Sl	1 Car			053	7.5	Jo	080	7.7	Hm	071	8.0	Cm
075	8.2	Pt	041	12.0	Ht	*094262*			056	7.1	Ah	080	7.4	Rb	071	6.9	Hf
S CMi			042	11.4	Bl	973	4.1	En	056	7.2	Hf	083	7.5	Hs	073	7.3	Bu
072708			064[	12.4	Ht	975	3.9	En	061	7.5	Td	086	7.5	Hs	075	7.8	Kp
066	11.4	Cm				976	3.7	En	061	7.2	Hi	086	7.5	Dl	075	7.8	Rb
075	11.6	Pt				977	3.7	En	061	7.0	Bu				076	7.5	Rb

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs.

Z UMA
115158
078 7.5 Rb
079 7.5 Bu
080 7.9 Rb
081 7.9 Me
083 8.2 Gy

R CRV
121418
985 11.2 Sl
035 12.7 Sl

T CVN
122532
072 10.5 Md

U CEN
122854
030 8.5 Bl
041 8.2 Ht
042 8.2 Bl
046 8.3 dK
051 8.7 Ht
055 8.5 dK
062 8.6 Ht
063 8.4 dK
066 8.3 Ht
071 8.7 dK

T UMA
123160
052 12.0 So
062 12.3 Pt
064 12.0 Kg
066 12.1 So
066 12.3 Rb
074 12.3 So
075 12.3 So
080 12.3 Rb

RS UMA
123459
047 12.2 Ry
052 12.3 So
054 11.8 Ry
060 11.6 Ry
062 11.2 Pt
065 11.1 Md
065 11.3 Ry
066 11.1 So
066 11.2 Rb
066 11.1 Cm
066 11.3 Kn
067 11.1 Gy
067 10.3 Mc
068 11.0 Mn
069 11.0 Md
069 10.8 Ry
069 11.4 Jo
071 10.8 Jo
072 10.9 Md
073 9.9 Mc
074 10.4 Md
074 10.4 So

RS UMA
123459
075 10.4 Ry
075 9.8 Mc
076 10.0 Jo
076 10.0 Mn
079 9.5 Mc
080 10.4 Rb
080 8.7 Jo
082 9.5 Me
084 9.0 Md
090 8.9 Md
094 8.7 Md

S UMA
123961
045 11.4 Ah
052 11.3 So
058 11.4 Wp
061 10.6 Wp
061 10.6 Wa
062 10.9 Hf
062 10.6 Pt
062 10.6 Gy
064 10.5 Kg
066 10.5 Mc
066 10.3 Kn
066 10.3 So
066 10.8 Ah
066 10.2 Rb
066 10.4 Cm
066 10.4 Hf
067 10.6 Gy
067 10.1 Hk
067 10.4 Mc
068 10.4 Mn
069 10.5 Sh
069 10.3 Jo
069 10.6 Hf
071 9.9 Jo
073 10.2 Mc
074 10.0 So
074 10.3 Ah
075 10.2 Dl
075 10.1 Mc
076 9.8 Dl
076 9.9 Jo
076 9.9 Mn
078 9.5 Dl
079 9.4 Mc
080 9.1 Rb
080 9.2 Dl
082 9.2 Me
083 9.0 Wp
083 9.3 Wa

U OCT
131283
030 12.0 Bl
042 12.9 Ht
064 13.1 Ht

V CVN
131546
057 7.1 Lt
067 7.4 Lt

R HYA
132422
005 4.9 Kd
012 4.9 Kd
030 5.2 Bl
041 5.3 Ht
042 5.5 Bl
046 5.8 dK
050 5.6 Ht
062 6.2 Ht

S VIR
132706
041 8.9 Ht
050 8.1 Ht
062 7.3 Ht

RV CEN
133155
030 7.5 Bl
041 7.4 Ht
042 7.5 Bl
046 7.0 dK
050 7.3 Ht
055 6.8 dK
062 7.3 Ht
063 6.6 dK
066 7.3 Ht
071 6.7 dK

T UMI
133273
062 11.7 Hf
067 11.8 Hk
069 12.3 Wd
071 11.9 Cm

T CEN
133633
974 6.8 En
979 6.8 Ht
983 7.2 En
985 7.4 Ht
989 7.3 Sl
990 7.9 Ht
990 7.6 Bl
004 8.0 Ht
012 7.9 Ht
030 6.1 Bl
036 6.0 Sl
041 5.9 Ht
042 5.9 Bl
050 6.2 Ht
062 6.7 Ht
066 7.2 Ht

RT CEN
134236
030 9.4 Bl
041 10.0 Ht
042 9.4 Bl

RT CEN
134236
050 10.1 Ht
062 10.4 Ht
066 10.4 Ht

R CVN
134440
005 4.9 Ah
012 4.9 Ah
030 5.2 Bl
041 5.3 Ht
042 5.5 Bl
046 5.8 dK
050 5.6 Ht
062 6.2 Ht

S VIR
132706
041 8.9 Ht
050 8.1 Ht
062 7.3 Ht

RV CEN
133155
030 7.5 Bl
041 7.4 Ht
042 7.5 Bl
046 7.0 dK
050 7.3 Ht
055 6.8 dK
062 7.3 Ht
063 6.6 dK
066 7.3 Ht
071 6.7 dK

T UMI
133273
042 8.5 Bl
042 8.9 Ht
051 9.1 Ht
064 9.5 Ht

Z BOO
140113
048 14.2 Wu

Z VIR
140512
045⌈13.8 Wu
066⌋13.5 Ht

RU HYA
140528
031 12.6 Bl
041 12.6 Ht

R CEN
140959
990 7.5 Sl
031 6.8 Bl
036 6.2 Sl
041 6.1 Ht
042 6.4 Bl
046 5.9 dK
050 6.0 Ht
055 6.2 dK
062 5.9 Ht
063 6.3 dK
066 5.9 Ht

R CEN
140959
037 9.8 Ah
045 9.5 Ah
049 9.6 Hi
051 9.3 Cl
053 9.8 Jo
055 9.0 Kn
055 9.2 Cl
056 9.4 Ah
056 9.5 Hf
056 9.8 Hi
059 9.5 Hi
059 9.2 Cl
061 9.5 Hf
062 9.0 Md
062 9.2 Ah
062 9.2 Pt
062 9.3 Gy
063 8.9 Cl
063 8.9 Sf
065 8.8 Md
066 9.1 Ah
066 9.5 Hf
066 8.9 Jo
067 9.3 Cl
067 9.0 Gy
067 9.0 Hk
067 8.8 Bu
069 9.4 Sh
069 9.5 Sz
069 8.8 Md
069 9.1 Wd
069 9.4 Hf
069 9.4 Hi
070 9.2 Ah
071 9.4 Cm
072 8.4 Md
073 9.2 Cl
074 9.1 Ah
075 8.2 Fa
075 8.7 Jo
076 8.6 Md
077 8.8 Bu
080 8.7 Jo
081 8.4 Md
084 8.8 Md
090 8.3 Md
093 8.2 Md
095 8.3 Md

S BOO
141954
061 12.8 Cm
063 12.7 B
069 12.5 Wd
069 12.6 Cm

U UMI
141567
049 8.5 Dh
060 8.5 Pb
060 8.5 Dh
061 8.1 Bu
061 8.1 Hf
062 8.0 Pt
062 8.0 Hm
062 7.9 Sx
063 7.8 Mc
063 8.6 Pb
063 8.0 Sf
064 8.6 Pb
064 8.5 Dh
065 7.9 Hm
066 7.7 Mc
066 8.0 Ah
066 7.7 Jo
066 8.0 Hm
067 7.8 Mc
068 8.3 Cr
068 7.9 Mn
068 7.8 Hm
069 8.2 Sh
070 7.9 Hm
071 8.0 Hf
071 7.4 Jo
073 7.8 Mc
073 7.6 Bu
074 8.1 Ah
074 8.3 Pb
075 7.9 Mc
075 7.9 Hm
076 7.5 Jo
076 8.0 Mn
076 8.3 Dh
076 7.9 Hm
078 8.0 Hm
080 8.1 Hm

R CAM
142584
049 8.7 Br
049 8.8 Hi
053 8.1 Jo
055 8.7 Kn
056 8.7 Hf
059 8.7 Hi
061 8.5 Hf
066 8.2 Jo
071 8.1 Jo
071 8.6 Wd
071 8.6 Hf
076 8.8 Wd
076 8.2 Jo

V BOO
142539a
045 8.3 Ah
049 8.5 Pb
049 8.5 Dh
053 7.6 Jo
060 8.5 Pb
060 8.5 Dh
061 8.1 Bu
061 8.1 Hf
062 8.0 Pt
062 8.0 Hm
062 7.9 Sx
063 7.8 Mc
063 8.6 Pb
063 8.0 Sf
064 8.6 Pb
064 8.5 Dh
065 7.9 Hm
066 7.7 Mc
066 8.0 Ah
066 7.7 Jo
066 8.0 Hm
067 7.8 Mc
068 8.3 Cr
068 7.9 Mn
068 7.8 Hm
069 8.2 Sh
070 7.9 Hm
071 8.0 Hf
071 7.4 Jo
073 7.8 Mc
073 7.6 Bu
074 8.1 Ah
074 8.3 Pb
075 7.9 Mc
075 7.9 Hm
076 7.5 Jo
076 8.0 Mn
076 8.3 Dh
076 7.9 Hm
078 8.0 Hm
080 8.1 Hm

Variable Star Observations Received During October, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R Boo			S CrB			RS Lib			R CrB			R CrB			R CrB		
143227			151731			*151822*			154428			154428			154428		
026	8.4	Ss	044	8.2	Kd	061	10.7	Me	010	7.0	Kd	062	7.0	Rb	069	6.9	Rb
061	10.7	Cm	045	7.6	Ah	062	10.9	Ht	011	7.2	Hr	062	6.5	Sq	069	7.0	Hf
061	10.7	Hf	048	6.9	Je	063	10.8	dK	013	7.0	Hr	062	6.8	Mb	069	6.9	Ba
062	11.1	Pt	053	7.3	Kp	066	11.1	Ht	013	7.0	Kd	062	6.5	SK	069	7.0	Sa
065	11.5	Md	053	7.0	Hv	071	11.0	dK	014	7.0	Hr	062	6.8	Mg	069	7.0	Hv
066	12.0	Jo	053	6.7	Jo	RU Lib			016	7.5	Kd	062	7.0	Hv	069	7.0	Cm
069	11.5	Cm	053	7.3	Bc	*152714*			022	7.5	Kd	062	6.5	Jo	069	7.1	Wd
069	11.3	Sz	056	7.2	Hv	062	12.5	Pt	026	7.1	Ss	063	6.6	Ar	069	6.9	Kg
071	12.3	Jo	056	6.6	Ah	R Nor			031	7.4	Kd	063	7.1	Hv	069	6.7	Pt
S Lup			057	7.0	Cl	*152849*			035	7.4	Kd	063	6.7	Dh	069	6.8	Ar
144646a			061	7.2	Cm	035	13.3	Bl	036	7.2	Hr	063	6.6	Pb	070	7.1	Hv
041	8.4	Ht	061	6.6	Hf	041	13.0	Ht	036	7.2	Kd	063	7.0	Sx	070	6.7	Pt
051	8.3	Ht	061	6.8	Bu	066	13.0	Ht	038	7.5	Kd	063	6.6	Pt	070	6.7	Ar
062	8.7	Ht	061	7.0	Sx	X Lib			044	7.6	Hr	064	6.5	SK	070	7.1	Bc
066	8.5	Ht	062	7.0	Kp	*153020*			044	7.5	Kd	064	6.6	Pb	070	7.1	Hm
X Lup			062	6.6	Ba	035	12.4	Bl	045	7.0	Ah	064	7.0	Td	071	6.8	Sa
144646b			062	6.6	Sq	W Lib			048	7.1	Je	064	7.0	Hv	071	7.0	Rb
041	12.1	Ht	062	6.6	Jo	*153215*			049	6.5	Dh	064	7.0	Wd	071	6.0	Jo
066	12.1	Ht	062	6.2	Pt	036	13.4	Bl	049	6.5	Pb	064	6.7	Pt	071	7.0	Rc
U Boo			063	6.9	Hv	S UMi			050	7.0	Je	064	6.6	Ar	071	6.8	Wa
144918			063	6.9	Mc	153378			053	7.0	Bc	064	6.6	Dh	071	7.0	Wd
066	12.1	Jo	063	6.9	Sf	049	12.9	Hi	053	6.5	Jo	065	7.0	Hv	071	6.8	Td
071	12.1	Jo	065	6.7	Cm	059	13.0	Hi	053	7.0	Hv	065	7.1	Cm	073	6.7	Ar
Y Lup			066	6.8	Kp	061	12.3	Me	053	6.8	Kp	065	6.8	Rc	073	7.0	Hv
145254			066	6.8	Mc	062	12.4	Gy	054	7.3	Kd	065	6.5	Wa	073	7.0	Bu
031	12.8	Bl	066	6.5	Ah	062	11.9	Pt	055	7.0	Hv	065	6.6	Pt	074	7.0	Ah
051	12.8	Ht	066	6.4	Jo	066	11.7	Jo	056	6.9	Hv	065	7.0	Hm	074	6.5	Ra
066	12.8	Ht	067	6.7	Mc	067	12.4	Hk	056	6.9	Hf	066	6.7	SK	074	6.5	Pt
S Aps			068	6.9	Je	069	12.6	Gy	056	6.9	Ah	066	7.0	Kp	074	6.6	Ar
145971			068	6.7	Rl	071	12.0	Jo	057	7.0	Hv	066	7.0	Rb	075	6.8	Ba
990	10.8	Sl	068	6.9	Dl	071	12.7	Cm	057	6.6	Me	066	6.8	Hf	075	7.1	Hv
031	10.3	Bl	068	6.7	Mn	075	12.4	Fa	058	7.0	Hv	066	7.0	Cm	075	6.8	Kp
035	10.2	Bl	069	7.0	Sz	U Lib			059	7.0	Hf	066	6.2	Io	075	6.0	Mo
036	10.4	Sl	069	6.3	Ba	*153620a*			059	6.8	Me	066	6.8	Wa	075	6.9	Rb
041	10.3	Ht	069	6.9	Cl	036	10.1	Bl	060	6.9	Hv	066	6.8	Kg	075	7.0	Hf
042	10.0	Bl	070	7.2	Hv	043	10.5	Bl	060	6.3	Pb	066	7.0	Hs	075	6.9	Kg
051	10.3	Ht	071	6.7	Hf	T Nor			060	6.6	Me	066	7.0	Ah	075	6.9	Dl
062	10.2	Ht	073	7.1	Mc	*153654*			060	6.4	Pt	066	6.7	Pt	075	6.5	Pt
066	10.2	Ht	073	7.0	Bu	041	10.8	Ht	060	6.3	Ar	066	7.0	Hm	075	6.6	Ar
Y Lib			074	6.4	Ah	046	10.6	dK	060	7.0	Bu	066	6.8	Gy	075	6.9	Hm
150605			075	7.0	Kp	051	10.2	Ht	060	6.3	Dh	067	7.0	Hv	076	6.6	SK
061	11.0	Me	075	6.4	Ba	055	9.5	dK	061	7.0	Rb	067	6.9	Ku	076	7.1	Hv
S Lib			075	7.0	Mc	062	8.6	Ht	061	6.9	Hf	067	6.7	Ar	076	6.9	Rb
151520			076	6.5	Jo	063	8.2	dK	061	7.0	Cm	067	7.0	Bu	076	6.3	Jo
061	9.1	Me	076	6.8	Mn	066	8.3	Ht	061	7.0	Wd	067	6.5	Gy	076	6.8	Td
S Ser			077	7.3	Bc	071	7.8	dK	061	6.9	Hs	068	6.7	Pt	076	7.0	Fa
151714			078	6.9	Dl	RR CrB			061	6.7	Me	068	6.9	Dl	076	6.7	Pt
061	11.0	Hf	079	7.0	Mc	153738			061	6.4	Ra	068	6.5	Lf	076	7.0	Hm
062	10.5	Jo	089	6.4	Ba	057	8.0	Lt	061	6.6	Ar	068	6.5	Ar	076	6.7	Dh
062	10.9	Pt	RS Lib			065	8.0	Lt	061	6.7	Sx	068	7.0	Hm	077	7.0	Rc
064	10.7	B	*151822*			072	8.0	Lt	062	6.8	Ah	068	6.8	SK	077	7.1	Bc
066	10.4	Jo	031	8.6	Bl	078	8.0	Lt	062	6.8	Fn	068	7.1	Hv	078	7.0	Dl
069	10.7	Hf	041	9.9	Ht	Z Lib			062	6.4	Pt	068	6.9	Rb	078	6.7	Me
069	10.5	Sh	043	9.3	Bl	*154020*			062	7.1	Hm	068	6.9	Je	078	7.0	Fa
071	9.8	Jo	046	9.9	dK	036	13.3	Bl	062	7.0	Sx	068	6.5	Pb	078	6.6	Pt
076	10.0	Jo	051	10.3	Ht	R CrB			062	6.8	Hf	068	7.0	Rl	078	7.1	Hm
079	9.3	B	055	10.4	dK	154428			062	7.0	Gy	068	6.6	Wa	079	6.8	Rc
						005	7.0	Kd	062	6.9	Kp	068	6.5	Dh	079	6.9	Bu

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R CrB			V CrB			Z Sco			SX Her			V Her			W Her		
154428			154639			*160021*			160325			162119			163137		
079	7.1	Hm	062	6.9	Pt	060	10.3	Me	074	8.1	Bu	978	8.5	Fn	063	12.7	Pt
080	6.8	Rb	063	7.5	Md	062	11.0	Ht	075	8.2	Ba	025	9.2	Ss	066	12.8	Rb
080	6.9	Hs	063	8.0	Mc	066	11.2	Ht	075	8.0	Mc	026	9.3	Ss	067	13.2	Rl
080	7.2	Hm	064	7.6	B	R Her			076	8.1	Pt	049	10.0	Hi	068	13.0	Pb
080	6.8	Dl	064	7.7	Bu	160118			076	8.6	Jo	053	10.1	Jo	068	13.0	Dh
080	7.0	Fa	065	7.7	Bu	062	[13.1	Pt	078	8.2	Rb	059	9.9	Me	069	13.1	Dh
080	6.6	Pt	065	8.0	Cm	U Ser			078	8.0	Pt	060	10.3	Hi	069	13.0	Ar
081	6.6	Me	066	7.0	Ba	160210			078	8.3	Me	061	9.7	Td	069	13.0	Pb
082	6.6	Me	066	7.5	So	053	9.3	Jo	079	8.2	Lt	061	10.2	Hf	070	13.4	Ar
083	6.9	Rc	066	7.6	Rb	057	8.7	Me	080	8.1	Pt	062	10.0	Jo	074	13.0	Ar
083	6.5	Rl	066	7.8	Hf	058	9.1	B	081	8.0	Me	063	10.1	B	074	13.0	Dh
083	6.9	Hs	066	7.4	Jo	061	8.8	Hf	082	8.2	Me	063	10.3	Pt	075	13.0	Ar
083	6.5	Pt	067	8.3	Mc	061	8.9	Bu	083	8.1	Pt	066	10.9	Kp	076	13.0	Dh
085	7.0	Hm	067	8.1	Hi	061	9.3	Sx	083	8.4	Cm	066	11.0	Mc	076	13.3	Rb
085	6.9	Wd	068	8.4	Wa	062	9.4	Pt	085	8.0	Me	066	10.6	Rb	076	13.0	Pb
085	6.5	Me	068	7.6	Rb	062	9.3	Jo	089	7.9	Ba	066	10.4	Jo	083	[13.2	Cm
086	7.1	Hs	069	7.7	Md	065	9.2	Lt	W Sco			067	10.7	Gy	R UMi		
086	7.1	Dl	069	8.2	Cm	066	8.9	Jo	*160519*			067	10.3	Hm	163172		
089	7.1	Hm	069	8.1	Hf	069	9.4	Hf	036	[13.8	Bl	068	10.5	Kt	053	10.3	Jo
090	6.9	Tn	071	7.3	B	069	9.3	Fs	RU Her			070	10.1	Hm	056	10.1	Hf
090	6.8	Fl	072	7.7	Md	070	9.4	B	160625			071	10.1	B	061	9.9	Hf
X CrB			073	7.7	Bu	076	9.2	Jo	062	12.4	Pt	071	10.7	Hf	063	10.0	Hv
154536			073	7.7	Es	077	9.7	Bu	066	12.6	Rb	071	9.7	Td	065	10.0	Hv
049	9.5	Hi	073	7.9	Mc	078	9.5	B	067	12.6	Gy	075	10.4	Td	065	9.5	Bu
056	9.7	Hi	075	7.7	Mg	X Sco			070	12.6	B	075	10.1	Hm	066	10.3	Jo
059	9.9	Hi	075	7.5	BT	*160221a*			075	12.5	BT	076	10.4	Td	067	10.0	Hv
062	9.9	Pt	075	7.3	Ba	036	[13.0	Bl	075	12.6	Mg	076	10.3	Hm	067	9.8	Mc
063	9.8	Cl	075	8.3	Mc	061	12.0	Me	078	12.7	Rb	078	10.6	Dl	067	9.5	Kn
063	9.9	B	075	7.9	Fa	SX Her			R Sco			078	10.6	Fl	067	9.5	Hk
066	10.3	Jo	075	7.5	So	160325			*161122a*			078	10.6	Cr	068	10.0	Hv
067	10.0	Hi	076	7.6	Jo	053	8.6	Jo	036	[13.4	Bl	080	11.0	Jo	069	10.0	Hv
071	10.5	Jo	081	7.5	Md	057	7.9	Me	063	[12.4	Pt	083	11.0	Cm	069	9.5	Sh
075	10.6	BT	094	8.1	Es	057	8.1	Lt	066	12.7	Ht	085	10.9	Wd	069	9.6	Wd
075	10.9	Mg	095	7.6	Md	058	8.1	Me	S Sco			g Her			070	10.0	Bc
078	11.1	B	RR Lib			059	8.0	Me	*161122b*			162542			070	9.9	Hv
R Ser			*155018*			060	8.0	Me	036	[13.4	Bl	065	5.2	Lt	071	10.0	Jo
154615			060	10.9	Me	060	8.1	Pt	061	12.8	Me	071	5.2	Lt	071	9.7	Hf
061	11.0	Hf	062	11.4	Pt	061	8.2	Hf	066	12.6	Ht	086	5.0	Lt	071	9.6	Cm
062	10.2	Jo	Z CrB			061	8.0	Me	W CrB			SS Her			072	10.1	Bc
062	10.5	Pt	155229			062	8.0	Sq	161138			162807			073	9.8	Hv
066	9.9	Jo	045	13.5	Wu	062	8.4	Jo	063	13.7	B	978	10.5	Fn	075	9.7	Hv
066	9.8	Rb	075	[14.5	BT	062	8.0	Pt	063	12.5	Pt	053	12.1	Jo	076	9.7	Hv
072	8.7	Md	RZ Sco			063	8.3	Bu	069	13.0	Cm	061	12.8	Me	076	9.7	Jo
073	8.9	Es	*155823*			063	8.0	Pt	W Oph			062	12.0	Jo	076	9.5	Bu
076	8.5	Md	041	10.0	Ht	064	8.1	Pt	*161607*			063	12.3	Pt	077	9.9	Bc
093	7.1	Md	046	10.0	dK	065	8.0	Pt	063	12.0	Pt	064	12.7	B	079	9.8	Mc
095	7.3	Es	055	10.4	dK	065	8.1	Lt	V Oph			066	11.8	Jo	080	9.4	Jo
V CrB			060	10.9	Me	066	8.7	Mc	*162112*			071	12.7	B	085	9.5	Wd
154639			062	11.0	Pt	066	8.4	Jo	053	8.0	Jo	080	10.8	Jo	R Dra		
049	7.9	Hi	062	11.0	Ht	066	8.1	Pt	061	8.5	Hf	T Oph			163266		
052	8.0	So	063	10.9	dK	067	8.0	Gy	063	8.1	Pt	*162815*			037	7.5	Ah
053	7.2	Jo	066	11.0	Ht	068	8.2	Pt	066	8.3	Hb	036	[13.1	Bl	045	7.6	Ah
056	8.0	Hi	071	11.2	dK	069	7.8	Ba	066	7.8	Jo	S Oph			051	7.3	Cl
057	7.3	Me	Z Sco			069	8.1	Hf	069	7.7	Jo	*162816*			052	7.4	SK
059	7.9	Hi	*160021*			069	8.1	Pt	069	8.5	Hf	036	11.7	Bl	053	7.9	Kp
062	7.7	Sq	036	10.2	Bl	070	8.2	Pt	071	7.5	Jo	043	12.3	Bl	053	7.5	Jo
062	7.9	Hf	041	10.5	Ht	072	8.2	Lt							055	7.6	Cl
062	7.4	Jo	043	10.2	Bl	074	8.1	Pt							056	7.8	Ah

Variable Star Observations Received During October, 1935.

J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs.

R Dra
163266
056 7.8 Hf
057 7.4 Me
059 7.9 Cl
061 7.9 Hf
062 8.1 Kp
062 7.3 SK
062 7.7 Gy
062 7.8 Sx
063 7.9 Cl
063 7.8 Pt
064 8.1 Ah
065 8.0 Bu
066 7.9 Kp
066 7.6 SK
066 8.3 Ah
066 8.1 Hf
066 8.2 Jo
067 8.2 Cl
067 8.1 Gy
067 8.0 Hk
067 8.0 Kn
068 7.9 Mn
069 8.2 Sh
069 8.0 Wd
069 8.1 Hf
069 8.1 Gy
070 8.4 Ah
071 8.1 Jo
073 8.0 Cl
074 8.5 Ah
075 8.3 Kp
075 7.9 Fa
075 8.9 Dl
075 8.6 Hm
076 8.6 Hm
076 8.3 Bu
076 8.0 Mn
076 8.4 Jo
076 8.7 Dl
077 8.1 Ra
078 8.6 Hm
078 8.5 Dl
079 8.3 Gy
080 8.5 Dl
083 8.7 Hs
085 8.5 Wd

RR Oph
164319
063 12.5 Pt

TT Oph
164403
058 10.1 Wp
060 9.8 Hi
062 9.7 Md
062 9.9 Fn
062 9.7 Hf
063 9.0 B
063 9.5 Hk

TT Oph
164403
065 10.5 Pt
066 9.7 Jo
066 9.5 Kp
066 9.8 So
066 9.6 Hf
067 9.6 Hk
067 9.4 Hi
068 9.6 B
069 9.7 Cm
070 9.6 B
072 9.7 Md
075 9.9 B
076 10.1 Fa
076 10.1 Ba
080 10.5 B

S Her
164715
045 8.0 Ah
053 7.6 Jo
056 7.8 Ah
057 7.2 Me
060 7.7 Lt
062 7.2 Sq
062 7.7 Hf
062 7.2 Jo
065 6.7 Pt
065 7.4 Bu
066 8.0 Mc
066 7.5 Ah
066 7.5 Jo
067 7.8 Lt
068 7.8 Dl
071 7.9 Hf
072 7.8 Lt
073 7.7 Mc
074 7.6 Ah
075 7.9 Mc
076 7.5 Bu
078 8.4 Dl
079 7.8 Lt
080 7.8 Jo
083 8.3 Hs
083 8.4 Cm
085 7.9 Wd

RS Sco
164844
036 8.6 Bl
041 8.4 Ht
043 8.2 Bl
046 8.1 dK
051 8.0 Ht
055 8.1 dK
062 7.6 Ht
063 7.9 dK
066 7.5 Ht
071 7.8 dK

RR Sco
165030a
990 11.4 Sl
036 8.4 Sl
036 8.3 Bl
037 8.2 Kd
041 7.9 Kd
041 8.4 Ht
043 8.0 Bl
046 7.6 dK
051 7.7 Ht
055 7.6 dK
062 7.3 Ht
063 7.5 dK
066 7.4 Ht
071 7.4 dK

SS Oph
165202
045 13.1 Wu
068 12.2 Wu

RV Her
165631
052 13.6 So
061 12.8 Me
063 12.4 Cl
065 11.8 Pt
066 12.0 So
073 10.4 Es
075 9.9 Bb
075 10.4 BT
075 9.9 Mg
095 10.1 Es
095 10.4 Md

RT Sco
165636
037 8.3 Bl
043 8.1 Bl

TX Oph
165905
052 10.5 Cl
062 11.0 Kg
062 10.5 Fn
062 10.4 Rb
062 11.0 Cm
062 11.0 Hf
063 10.5 Cl
063 10.7 Hk
065 10.7 Es
065 10.6 Wa
065 11.0 Pt
066 11.0 So
066 10.8 Wa
066 10.6 Rb
066 11.1 Hf
067 10.5 Gy
067 10.7 Hk
069 10.5 Cl
069 10.3 Cm
071 11.0 Jo
073 10.5 Cl

TX Oph
165905
076 10.5 Ba
073 10.9 Es
076 10.1 Fa
078 9.9 Rb
083 10.1 Es
085 9.9 Es
094 10.1 Es
095 9.8 Es

RT Her
170627
057 9.4 Cl
059 9.9 Pf
059 9.7 Me
060 9.9 Hi
062 10.0 Hf
065 10.0 Pt
066 9.9 Jo
068 10.1 Kn
069 9.9 Hi
070 9.8 Cl
071 9.9 Jo
075 10.0 Hf
075 9.5 Bb
075 9.0 BT
075 9.5 Mg
076 10.0 Jo
080 10.0 Jo

RW Sco
170833
037 13.0 Bl

Z Oph
171401
053 9.0 Jo
056 9.7 Ah
057 9.4 Me
058 9.4 B
059 9.5 Me
062 9.7 Kg
062 9.8 Cm
062 9.4 Hf
062 9.3 Jo
063 9.4 Bu
065 9.2 Pt
066 9.8 Hb
066 9.5 Ah
069 9.3 Cm
069 9.8 Jo
070 9.9 B
071 10.0 Jo
074 9.7 Ah
077 9.7 Bu

RS Her
171723
056 8.7 Ah
060 8.8 Hi
062 8.9 Ah
062 9.0 Hf
063 9.0 Sf
065 9.0 Es
065 8.6 Pt
065 9.0 Md
066 8.8 So
066 9.0 Ah
066 9.2 Jo
066 9.0 Hb
067 9.1 Hi
069 8.9 Md
071 9.3 Jo
073 9.3 Es
074 9.4 Ah
075 9.5 Hf
075 9.0 Bb
075 9.4 BT
075 9.5 Mg
078 9.4 Rb
080 10.4 Jo
084 9.8 Md
094 10.0 Md

S Oct
172486
037 7.7 Bl
042 8.4 Ht
043 7.9 Bl
046 8.2 dK
051 8.3 Ht
055 7.9 dK
064 8.9 Ht
065 8.2 dK
071 8.8 dK

RU Oph
172809
065 11.3 Md
065 10.9 Pt
067 11.2 Gy
072 11.0 Md
076 10.2 Jo
080 10.0 Jo

RT Ser
173411
063 11.3 Mc
067 11.3 Mc
079 11.3 Mc

RU Sco
173543
037 10.5 Bl
043 10.6 Bl
046 10.6 dK
055 10.2 dK
063 10.1 dK
071 9.8 dK

SV Sco
174135
037 10.0 Bl
043 9.9 Bl

W Pav
174162
037 12.2 Bl
041 13.0 Ht
066 13.0 Ht

RS Oph
174406
990 11.5 Sl
038 11.0 Kd
042 10.7 Ht
051 10.8 Ht
058 10.4 Wp
059 10.4 Wp
060 11.1 Pt
061 10.6 Wa
061 10.8 Hi
061 10.4 Wp
061 10.4 Rb
062 11.3 Hf
062 10.4 Cm
062 10.4 Kg
062 10.5 Wp
062 10.6 Wa
062 10.8 Ht
064 10.4 Wa
065 11.3 Wu
065 11.2 Ry
066 10.5 Ba
066 10.9 Kn
066 11.4 Rb
066 10.6 Hf
066 10.4 Wa
066 11.0 Ht
068 11.1 Rb
068 10.3 Wa
069 10.8 Hi
069 10.8 Rb
069 10.5 Cm
069 10.7 Hf
069 11.5 Jo
069 10.9 Wd
070 11.0 Hf
071 10.9 Hf
071 11.2 Jo
071 10.4 Wa
074 10.6 Wu
075 10.2 Mo
075 11.2 Ry
075 10.6 Wp
075 10.8 Wa
076 11.4 Rb
076 11.0 Jo
078 10.4 Rb
078 10.8 Wa
078 10.6 Wp
079 10.5 Wp

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
RS OPH			**UY DRA**			**R PAV**			**RY OPH**			**d SER**			**R SCT**		
174406			175458b			*180363*			181103			182200			*184205*		
079	10.6	Wa	062	11.0	Rb	041	9.6	Ht	078	10.2	Rb	086	5.2	Lt	013	5.3	Hr
080	10.8	Wp	063	11.7	Ar	046	9.8	dK	078	9.8	Md	**SV HER**			022	5.3	Kd
080	10.8	Wa	064	11.6	Ar	051	10.5	Ht	079	9.7	B	182224			033	5.4	Kd
083	10.7	Wp	067	11.4	Ar	055	10.5	dK	080	10.0	Jo	051	13.9	Wu	034	5.2	Kd
083	10.8	Wa	067	11.0	Hk	062	11.0	Ht	094	11.5	Md	061	14.2	Wu	036	5.3	Sl
084	10.7	Wp	067	11.0	Dh	063	10.6	dK	**W LYR**			065	14.4	Wu	036	5.3	Kd
084	10.8	Wa	068	11.4	Ar	066	11.1	Ht	181136			**T SER**			037	5.5	Kd
088	10.7	Wp	069	11.4	Ar	071	11.4	dK	052	12.5	So	182306			038	5.2	Hr
088	10.8	Wa	069	11.5	Pb	**T HER**			064	12.4	Rl	075	13.7	B	039	5.5	Kd
089	10.9	Wd	069	12.0	Gy	180531			064	12.2	Wd	086	[12.8	Pt	044	5.2	Hr
U ARA			070	11.4	Ar	065	12.4	Pt	066	12.4	Cm	**RZ HER**			047	5.0	Bc
174551			073	11.6	Ar	066	[10.7	Hm	066	12.0	Hf	183225			048	5.5	Sq
041	[13.0	Ht	073	11.6	Cl	070	[11.0	Hm	066	12.5	Jo	069	9.5	Jo	049	5.4	Pb
066	13.0	Ht	074	11.8	Ar	072	12.9	B	067	12.0	Ar	071	9.4	Jo	049	5.4	Dh
RT OPH			075	11.7	Ar	075	[11.5	Hm	068	11.9	Ar	071	9.2	Kn	050	5.3	Fn
175111			075	11.7	Mg	076	[11.5	Hm	068	12.3	So	**Z OPH**			052	5.4	SK
051	13.7	Wu	075	11.9	BT	089	[10.2	Ba	068	12.0	Pt	183308			053	4.8	Sa
064	13.6	Wu	075	12.0	Bb	**W DRA**			068	11.9	Wu	053	7.8	Kp	053	5.1	Bc
068	13.4	Wu	075	11.5	Fa	180565			069	11.9	Gy	053	8.2	Jo	053	5.5	Kp
T DRA			078	11.2	Rb	052	13.7	Pf	069	11.9	Ar	057	7.6	Me	053	5.2	Jo
175458a			**RY HER**			065	[12.9	Pt	069	11.5	Ah	062	8.0	Sx	053	5.1	Hv
051	9.8	Cl	175519			**X DRA**			069	11.9	Pb	062	7.9	Kp	055	5.4	Jo
055	9.4	Cl	071	13.2	B	180666			069	11.9	Cm	062	8.1	Hf	055	5.2	Hv
060	10.6	Ar	076	13.0	Rb	052	[14.1	Pf	070	11.9	Ar	062	7.8	Jo	056	5.3	Hv
061	10.6	Ar	094	11.4	Es	**NOV OPH**			071	12.2	Jo	066	7.7	Kp	056	5.3	Hf
061	9.4	Cl	095	11.4	Md	180911			071	12.0	B	068	7.9	Mn	057	4.8	Sa
061	10.0	Hf	**V DRA**			060	13.0	Ar	073	12.0	Es	071	7.5	Rc	057	5.2	Me
062	10.2	Gy	175654			061	13.9	Ar	073	11.8	Kg	071	7.6	Kn	057	5.3	Hv
062	10.4	Rb	065	10.6	Md	063	14.0	Ar	073	11.9	Ar	073	7.5	Bu	058	5.3	Hv
063	10.5	Ar	065	11.5	Pt	064	14.1	Ar	074	11.8	Ar	075	7.7	Jo	058	5.2	Me
064	10.6	Ar	067	10.9	Kn	067	14.1	Ar	074	11.9	So	075	7.7	Kp	059	5.3	Hs
066	10.1	Hf	072	10.9	Md	068	14.1	Ar	075	11.9	So	075	8.0	Hf	059	5.2	Me
067	10.0	Cl	094	12.0	Md	069	14.1	Ar	075	11.5	Fa	076	7.6	Mn	060	5.2	Me
067	10.2	Gy	**VX SGR**			070	14.2	Ar	075	11.8	Hf	079	7.6	B	060	5.5	Hv
067	10.3	Dh	*180222a*			073	14.2	Ar	075	11.7	Ar	080	7.7	Jo	060	5.4	Pb
067	10.4	Hk	058	8.9	Wp	074	14.2	Ar	076	11.3	Hk	085	7.9	Wd	060	5.4	Pt
067	10.6	Ar	060	9.2	Hi	075	14.2	Ar	076	12.4	Jo	086	7.5	Pt	060	5.4	Ar
068	10.6	Ar	061	9.1	Hf	**RY OPH**			077	11.3	Ra	**RY LYR**			060	5.4	Dh
069	10.7	Ar	062	8.7	Md	181103			079	10.9	Gy	184134			061	5.6	Wd
069	10.1	Gy	062	9.1	Fn	053	8.5	Jo	083	10.2	Rl	059	10.5	Me	061	5.6	Rb
069	10.7	Pb	064	8.8	B	056	8.8	Cl	083	10.3	Es	062	10.5	Hf	061	5.4	Hf
070	10.3	Ar	065	9.1	Pt	062	8.8	Jo	089	10.5	Wd	064	10.6	Pf	061	5.7	Sx
073	10.3	Ar	066	8.9	Hf	062	9.2	Sx	089	9.5	Kg	066	9.5	Jo	061	5.2	Me
073	9.8	Cl	066	8.8	Ba	062	9.2	Hf	093	9.4	Md	069	10.4	So	061	5.3	Ar
074	10.4	Ar	067	8.4	Bu	063	9.5	Mc	094	9.4	Es	071	10.8	Kn	062	5.0	Kg
075	10.5	Ar	068	8.7	B	063	8.9	Lt	095	9.3	Md	075	10.5	Hf	062	5.3	Jo
075	10.1	Hf	069	8.8	Md	065	8.5	Pt	**RY SCT**			086	10.5	Pt	062	5.7	Mb
075	10.7	Mg	069	8.7	Cm	066	9.0	Jo	*181912*			**AY LYR**			062	5.6	Mg
075	9.8	BT	070	8.7	B	065	9.2	Md	063	10.2	Mc	184137			062	5.2	Cm
075	11.2	Bb	071	9.0	Hf	066	9.0	Kn	066	9.9	Mc	072	14.2	Br	062	5.4	SK
075	9.5	Fa	076	9.3	Jo	067	9.1	Lt	067	10.0	Mc	073	14.2	Br	062	5.4	Sq
078	10.4	Rb	076	8.8	Md	069	9.5	Sz	073	9.7	Mc	**R SCT**			062	5.2	Sa
079	10.7	Gy	076	8.9	Ba	070	9.1	Cl	075	10.3	Mc	*184205*			062	5.5	Rb
UY DRA			077	8.4	B	071	9.6	Jo	079	9.6	Mc	990	5.7	Sl	062	5.2	Kp
175458b			078	8.4	Bu	072	9.3	Md	**RV SGR**			006	5.3	Kd	062	5.5	Hf
060	11.6	Ar	084	8.7	Md	072	9.4	Lt	*182133*			010	5.8	Kd	062	5.3	Hv
061	11.7	Ar	093	8.6	Md	075	9.2	Mc	037	9.2	Bl	011	5.3	Hr	062	5.4	Pt
061	11.5	Cl				075	9.7	Hf	043	9.2	Bl	012	5.4	Kd	062	5.6	Hm

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R SCT			R SCT			R SCT			NOV AQL			V AQL			TY AQL		
184205			*184205*			*184205*			184300			*185905*			*190907*		
063	5.7	Sx	069	5.4	Hv	078	5.6	Pt	073	10.8	Pb	068	7.6	Mn	074	10.8	Ar
063	5.5	Pb	069	5.6	Rb	078	5.8	Bu	074	10.8	Ar	076	7.6	Mn	074	10.5	So
063	5.7	Pt	069	5.8	Fs	079	5.8	Mc	075	10.8	Ar	R AQL			075	10.9	Ar
063	5.5	Ar	069	5.6	Pb	079	5.7	Rc	075	11.2	Jo	190108			095	10.7	Es
063	5.5	Dh	069	5.6	Wd	079	5.7	Hm	076	10.7	Pb	060	10.8	Me	095	10.4	Md
063	5.8	Mc	069	5.6	Pt	080	5.7	Rb	076	10.5	Dh	062	11.2	Hf	S LYR		
063	5.0	Hv	070	5.5	SK	080	5.8	Dl	079	10.9	Cm	063	10.6	Cl	190925		
063	5.5	Hf	070	5.4	Hv	080	5.7	Hs	RX LYR			066	11.2	Jo	047	12.2	Br
064	5.8	Wd	070	5.6	Pb	080	5.7	Hm	185032			066	10.1	Ah	058	12.3	Wp
064	5.6	Pt	070	5.6	Pt	080	5.3	Jo	051	14.7	Wu	068	10.0	Pt	059	11.8	Me
064	5.1	Me	070	5.7	Ar	080	5.6	Pt	061	14.8	Ar	071	11.0	Jo	061	12.5	Wp
064	5.5	Ar	070	5.0	Bc	081	5.4	Me	063	14.9	Ar	071	10.6	Hf	061	12.4	Wa
064	5.5	SK	070	5.6	Hm	082	5.3	Me	064	14.8	Ar	071	10.4	Kn	062	12.2	Gy
064	5.3	Cr	071	5.4	SK	083	5.9	Rc	067	15.0	Ar	073	10.1	Bu	068	12.4	Wp
064	5.2	Hv	071	5.0	Sa	083	5.3	Me	068	14.7	Ar	074	10.5	So	068	12.2	Pt
064	5.5	Hf	071	5.7	Rb	083	5.6	Hs	069	14.9	Ar	074	10.1	Ah	069	11.8	Gy
064	5.5	Pb	071	5.2	Jo	083	5.6	Pt	070	14.7	Ar	076	10.5	Mn	070	12.2	Wp
064	5.3	Wa	071	5.2	Wa	085	5.8	Wd	073	14.8	Ar	085	10.1	Wd	071	12.2	Wa
064	5.2	Dh	071	5.3	Me	085	5.7	Hm	074	14.9	Ar	V LYR			075	12.4	Mo
065	5.5	Hm	072	5.7	Ac	085	5.6	Me	075	14.8	Ar	190529a			075	12.5	B
065	5.3	Dh	072	5.0	Bc	086	5.8	Rc	S CRA			062	10.7	Hf	078	12.4	Wp
065	5.4	Hv	072	5.2	Me	088	5.8	Pg	*185437a*			068	10.0	Pt	078	12.3	Wa
065	5.8	Rc	073	5.6	Ar	090	5.5	Fl	990	12.0	Sl	069	11.0	So	079	12.2	Gy
065	5.3	Pb	073	5.4	Hv	090	5.4	Tn	036	11.9	Sl	069	10.5	Md	X LYR		
065	5.5	Pt	073	5.4	Hk	RW LYR			037	11.7	Bl	071	10.7	Kn	190926		
066	5.6	SK	073	5.7	Mc	184243			042	11.7	Ht	071	10.6	Hf	068	9.0	Pt
066	5.1	Kp	073	5.2	Me	051	14.4	Wu	043	12.1	Bl	071	10.7	Jo	RS LYR		
066	5.1	Kg	073	5.5	Pb	067	14.3	Wu	064	12.2	Ht	071	11.1	Me	190933a		
066	5.7	Rb	073	5.0	Kg	Nov AQL			R CRA			071	11.0	Hu	047	14.0	Br
066	5.3	Pt	073	5.6	Bu	184300			*185537a*			075	11.0	Wp	069	14.1	So
066	5.5	Hf	074	5.7	Pt	050	10.8	Fn	990	12.7	Sl	075	11.3	Wa	075	14.9	Wa
066	5.0	Wa	074	5.6	Ar	053	11.3	Jo	036	12.7	Sl	RX SGR			RU LYR		
066	5.8	Mc	075	5.4	Mo	060	11.6	Pt	037	13.0	Bl	*190818*			190941		
066	5.0	Jo	075	5.0	Kp	060	10.8	Pb	042	12.3	Ht	042	12.7	Ht	068	12.3	Pt
066	5.7	Hm	075	5.3	Hv	060	11.1	Ar	043	13.1	Bl	064	12.7	Ht	075	15.0	Wa
067	5.3	Hv	075	5.6	Ar	061	10.9	Ar	064	12.5	Ht	RW SGR			U DRA		
067	5.7	Sq	075	5.7	Rb	062	11.0	Jo	T CRA			*190819a*			190967		
067	5.7	Mc	075	5.6	Hf	063	11.0	Hv	*185537b*			042	10.2	Ht	052	13.9	Pf
067	5.0	Kg	075	5.8	Mc	063	10.9	Pb	990	13.0	Sl	061	10.6	Hf	068	13.4	Pt
067	5.5	Ar	075	5.0	Jo	063	10.7	Ar	036	13.0	Sl	064	10.6	Ht	073	13.8	Es
067	5.6	Bu	075	5.6	Kg	064	10.7	Ar	037	13.0	Bl	068	10.3	Bu	075	13.5	Wp
067	5.6	Hm	075	5.7	Dl	064	10.5	Dh	042	12.5	Ht	068	9.7	Pt	075	13.8	Wa
068	5.6	SK	075	5.6	Hm	064	10.7	Pb	043	12.9	Bl	071	10.6	Hf	095	13.3	Es
068	5.6	Ar	076	5.5	Me	065	10.9	Pb	064	12.5	Ht	TY AQL			W AQL		
068	5.2	Hv	076	5.6	SK	065	10.6	Dh	Z LYR			*190907*			*191007*		
068	5.6	Rb	076	5.5	Hv	067	10.7	Ar	185634			060	11.0	Ar	060	13.3	Ar
068	5.6	Kn	076	5.6	Hm	067	10.6	Gy	050	13.0	Wu	061	10.6	Ar	061	13.6	Ar
068	5.5	Pb	076	5.7	Rb	068	10.9	Rl	051	13.0	Wu	062	10.5	Hf	963	13.3	Ar
068	5.5	Wa	076	5.5	Dh	068	10.7	Dl	067	13.5	Wu	063	11.1	Ar	064	13.4	Ar
068	5.5	Dh	076	5.7	Dl	068	10.8	Pb	068	12.7	Pt	067	10.6	Ar	067	13.4	Ar
068	5.0	Kg	076	5.5	Pt	068	10.6	Dh	069	13.4	So	068	10.6	Ar	068	13.2	Ar
068	5.5	Dl	076	5.8	Mn	068	10.9	Ar	SU SGR			068	10.4	Pt	069	13.4	Ar
068	5.5	Lf	077	5.5	Rc	069	10.7	Ar	*185722*			069	10.8	Pb	070	13.5	Ar
068	5.6	Pt	077	5.4	Me	069	10.8	Pb	042	8.7	Ht	069	10.5	Md	073	13.8	Ar
068	5.9	Mn	077	5.4	Bc	070	10.8	Pb	064	8.5	Ht	069	10.8	Ar	074	14.0	Ar
068	5.7	Kt	078	5.5	Hm	070	11.0	Bc	RT LYR			070	10.4	Ar	075	14.0	Ar
069	5.6	Ar	078	5.7	Rb	070	10.8	Ar	185737			071	10.4	Hf	095	14.3	Es
069	5.3	Sa	078	5.7	Dl	073	10.8	Ar	069	13.6	So	073	10.6	Ar			

REMAINDER OF OBSERVATIONS AND SUMMARY TO APPEAR IN JANUARY.

First Vice-President, Charles W. Elmer, Second Vice-President, L. E. Armfield. Messrs. Witherell, Olcott, and Campbell were re-elected as Treasurer, Secretary, and Recorder, respectively.

Sixteen candidates were elected to membership, including one from Australia and two from Japan. Dr. G. B. Kuiper gave the main address at the Saturday afternoon session, talking on "Binary Stars." Dr. A. Wallenquist illustrated his trip from Java to San Francisco, California, with some excellent movie reels. The guest speaker of the evening was Dr. Robert King, formerly of Mount Wilson Observatory and now at the Massachusetts Institute of Technology, who spoke on the selection of the site for the proposed 200-inch reflector.

The recently installed Harvard-Technology Spectrohelioscope was exhibited to members, many of whom, for the first time, had the opportunity of viewing a solar prominence without the aid of a solar eclipse. Dr. Shapley in his address of acceptance of the Presidency mentioned some of the plans which he has for the extension of the activities of the Association. Among these, were the encouragement of a photographic patrol of the sky by interested members; a photographic study of special variables; confirmation of suspected variables; study of variables in red light; and the further training of members and others in computational work on occultations.

New contributors are S. J. Fairbanks, Waterloo, Iowa; E. D. Thorne, Wantagh, Long Island, New York, and A. De Vany, of Davenport, Iowa.

The annual report shows that our activities are in no wise lessening. With an annual total of more than 54,000 observations, we have now passed the half million grand total mark. There has been a large increase in the number of participating observers, due in the main to the interest aroused in the recent Nova in Hercules.

Jones heads the list of contributors with a total of 4324 to his credit. Peltier comes second with 2694, and then follow Armfield, with 2503, and Hartmann, with 2219. In the 1000 to 2000 class are, Houghton, Chandra, Focas, Baldwin, Doolittle, Hamilton, Peck, Watson, Gregory, Ahnert, and Ensor.

We are now starting our twenty-fifth year as a variable star observing group. With new variables recently added to the observing list, special observations of red variables in red light being contemplated, and an ever-increasing membership of really active observers, the end of our first quarter century of activity should be one of which we can be justly proud.

LEON CAMPBELL, *Recorder.*

November 11, 1935.

Comet Notes

By G. VAN BIESBROECK

There is little of interest to mention this month in regard to comets. No new ones have been announced and only three very faint ones are under observation with the help of large telescopes.

COMET VAN BIESBROECK (1935 *d*) has not changed its appearance appreciably. Last night (November 23) the brightness was estimated as 15^{M} by the writer. The ephemeris on p. 543 of this volume still holds fairly well since the correction was only -4^{s} and $-0'.2$ on that date. The object is now moving into the evening sky and will no longer be observable after the end of December; but next spring the conditions of visibility will become favorable again.

Periodic Comet Comas Solá (1927 III) has now passed its maximum brightness which was not more than 13M.5 on November 22. At that date it still showed a well marked tail pointing away from the sun. It is very close to the ephemeris given on p. 541 which is continued here as follows:

1935 U.T.		α h m	δ ° ′	Mag.
November	30.0	11 23.3	+18 56	13.1
December	8.0	11 38.6	18 24	
	16.0	11 52.7	18 02	
	24.0	12 5.1	17 49	
December	32.0	12 15.8	+17 47	13,2

The expected presence of Periodic Comet Schwassmann-Wachmann (1929 I) was verified here last night in the morning sky by the writer; this object appeared as a round coma of magnitude 14.5 from which emerged a faint tail 3′ in length, pointing away from the sun. It was found exactly in the place indicated by the following ephemeris computed by H. Q. Rasmussen (Circ. I.A.U. 558):

1935 U.T.	α h m s	δ ° ′	—Distance from— Earth	Sun
Dec. 4.0	12 18 19	+0 6.0	2.41	2.21
8.0	24 39	−0 28.1		
12.0	30 48	1 0.7		
16.0	36 45	1 31.8		
20.0	42 30	2 1.2		
24.0	48 1	2 28.7		
28.0	53 18	2 54.3		
32.0	12 58 21	−3 17.9	2.16	2.29

The present return of this comet has been very unfavorable. It was recovered here 1934 December 11 and followed until March 5 of this year, after which it passed behind the sun. The perihelion passage on August 29 remained unobservable and it is only now that this faint object comes again in reach of the telescope. It will probably be followed for several months hence.

Williams Bay, Wisconsin, November 23, 1935.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

As the moon was full at the maximum of the Perseids in 1935, it was not considered wise to request the coöperation of the public in observing them. It also happened that cloudy weather was prevalent on the Perseid nights over much of the country, so that many of our members found observing impossible. Because of these two factors, far fewer reports than usual are at hand concerning this epoch. Some additional ones made by members who are coöperating in the Hoffmeister-Olivier program unfortunately have not yet been sent in, so our analysis can not now be complete.

Table I gives the observed rates on Perseid nights. On the basis of these data, it appears that the maximum came on the night of August 11, as usual, the rate from 15h to 16h being larger in the western part of the country. Our able regional director in Oregon, Prof. J. Hugh Pruett, had most success in getting his group to take an active part in observing the shower. He was also able to photograph two trails, one of a —1 or —2 magnitude Perseid which left a most interesting path on the plate, about 10° long and showing two distinct flare-ups near

TABLE I

1935 PERSEIDS

Observer	Place	1935 Aug.	Began	Ended	Total Time	No. Met.	Rate	Remarks
R. Gardner Reed, Fall River, Mass.		10-11	13:00	15:00	120	55	27.5	1, 15
James S. Andrews, Monroe, N. Y.		12-13	14:30	15:50	80	4	...	1, 2, 15
Max Slonk, Bronx, N. Y.		11-12	12:30	15:30	135	23	10.2	3, 4
Anesta Friedman, Ithaca, N. Y.		12-13	11:05	13:15	130	76	35.1	4, 5
Robert Fleischer, Cooperstown, N. Y.		11-12	13:20	16:00	160	108	40.5	4, 5
Alfred Schenkman, Newmarket, N. J.		8- 9	13:10	15:20	130	16	7.4	1
		9-10	12:50	15:00	130	15	6.9	1
Franklin W. Smith, Glenolden, Pa.		9-10	13:00	15:30	150	23	9.2	1, 15
T. K. Tomkins, North Hills, Pa.		9-10	13:50	16:15	145	21	8.7	1, 15
R. A. Binckley, Upper Darby, Pa.		11-12	11:00	14:00	180	8	2.7	1, 7, 15
B. S. Whitney, Upper Darby, Pa.		11-12	11:00	13:55	90	4	2.7	1, 7, 15
Alfred G. Reid, Baltimore, Md.		11-12			60	39	39.0	5
		11-12			60	38	38.0	5, 6
P. O. Parker, Cohutta, Ga.		10-11	11:00	15:00	240	28	7.0	1, 15
J. Thurston Kent, Jackson, Tenn.		11-12	12:30	14:20	110	8	4.4	1, 7
John Forbes, Montreal, Canada		10-11	10:42	12:09	87	5	...	1, 8, 15
		13-14	11:45	12:57	72	7	...	1, 8, 15
		14-15	10:46	12:12	86	4	...	1, 8, 15
Marjorie Preucil, Joliet, Ill.		11-12	8:45	9:45	60	7	7.0	5
			10:45	11:45	60	10	10.0	5
			14:55	15:55	60	15	15.0	5
W. C. Woodley, Joliet, Ill.		10-11	10:00	12:00	120	8	4.0	5
Russell Anderson, Chicago, Ill.		11-12	12:45	13:50	65	6	5.5	1, 15
J. L. Black, Avon Lake, Ohio		10-11	13:00	16:20	200	30	9.0	1, 15
		11-12	15:03	16:33	90	21	14.0	1, 15
David Dickinson, Denver, Colo.		9-10	14:36	15:16	40	30	45.0	5
		10-11	14:35	15:25	50	45	54.0	5
J. Hugh Pruett, Eugene, Ore.		10-11	13:30	14:00	30	19	38.0	5, 9, 15
		11-12	14:15	15:45	90	92	61.4	5, 9, 15
		12-13	14:45	15:45	60	16	16.0	5, 9, 15
Mrs. J. Hugh Pruett, Eugene, Ore.		11-12	14:15	15:45	90	70	46.7	5, 10
		12-13	14:45	15:45	60	6	6.0	5, 10
Betty Jane Thompson, Eugene, Ore.		10-11	13:46	14:46	60	85	...	5, 11
		11-12	14:00	15:00	60	119	...	5, 11, 12
		12-13	15:00	16:08	68	71	...	5, 11
Gladys Wilson, Eugene, Ore.		11-12	13:53	14:13	20	8	...	13
Julian W. Graham, Salem, Ore.		11-12	15:06	16:06	60	30	30.0	14, 15
John D. Buddhue, Pasadena, Calif.		10-11	10:55	15:00	245	39	9.6	1, 15
		11-12	9:00	10:00	60	11	11.0	5, 15

REMARKS.

1. Paths plotted.
2. Increasing haze, small clouds, moonlight.
3. Notes on first ten meteors.
4. Member of the Junior Astronomy Club.
5. Count.
6. Another observer working independently at the same time.
7. Very poor sky.
8. Times of first and last meteor, not beginning and ending times.
9. Facing NE; at least two-thirds of the meteors Perseids.
10. Facing W; about five-sixths Perseids.
11. Three observers; group count with duplicates eliminated.
12. Thirty-four seen between 15:10 and 15:20.
13. Count facing S through window.
14. Notes on each.
15. American Meteor Society member.

the middle. While meteor photography is difficult, it is by no means impossible, and an increasing number of observers are making successful attempts. For the simultaneous photographs which were reported in these notes last month, both lenses were of the Tessar type, and for both cameras the focal ratio was f 4.5. From station 1 the aperture was 46 mm; from station 2, it was 40 mm.

A list of radiants is given as Table II. This completes the A.M.S. list for 1927, and gives 1933 radiants derived by McIntosh from his own observations and those of Geddes.

TABLE II

RADIANTS

A.M.S. No.	1927	α	δ	No of Meteors	Wt.	Observer	Remarks
1593	Oct. 22	34°5	+ 7°	6	Fair	C.P.O.	See 609?
1594	Oct. 22	43	+24.5	5	Good	C.P.O.	See 676
1595	Oct. 23	43	+ 5	6	Good	O.E.M.	See 1564?, 1270
1596	Oct. 23	45	+18	5	Good	O.E.M.	See 672, 678
1597	Oct. 20	45	— 2	4	Poor	O.E.M.	See 675?, 1561
1598	Oct. 20	47	+11	9	Good	O.E.M.	See 101
1599	Nov. 14	49	+11	7±	Poor	S.B.	
1600	Oct. 23	55	+14	4-7	Fair	S.B.	See 1562?, 131
1601	Oct. 20-21	55	+ 6	4	Good	C.M.P.	See 1310?
1602	Nov. 26-27	66	+15	5	Poor	O.E.M.	See 1314?
1603	Dec. 5	69	+ 9	4-5	Fair	C.F.K.	
1604	Nov. 26-27	82.5	+18.5	7±	Fair	O.E.M.	See 1571?
1605	Nov. 26-27	88.5	— 1	5-6	Good	O.E.M.	
1606	Nov. 17-18	90	+36	4-6	Good	S.B.	
1607	Oct. 19	90.9	+15.3	7	V.Good	R.A.M.	Orionids
1608	Oct. 20	91	+12.5	11+	Good	O.E.M.	Orionids
1609	Oct. 20	93.0	+15.0	17	V.Good	C.P.O.	Orionids
1610	Oct. 23	94	+13.5	15	Good	O.E.M.	Orionids
1611	Oct. 23	95.5	+15	15±	Good	C.M.P.	Orionids
1612	Oct. 22	95.8	+15.4	16	V.Good	C.P.O.	Orionids
1613	Oct. 23	98	+15	2-4	Good	C.P.O.	Orionids
1614	Oct. 23	102	+12	5	Good	C.P.O.	Orionids
1615	Oct. 23	114.5	—23	2	Good?	C.P.O.	
1616	May 11-12	178	—72	5	Good?	R.A.M.	
1617	May 11-12	191	—58	4-6	Good	R.A.M.	
1618	Jun. 23-26	277	+13	6	Poor	O.E.M.	
1619	Jun. 2	322	—52	6-7	Good	R.A.M.	
1620	Aug. 4-5	323	—21	5+	Poor	O.E.M.	See 2631?
1621	Jun. 3	328	—50	6	Good	R.A.M.	
1622	Aug. 4	329	+12	4	Good	O.E.M.	See 1486?
	1933						
2820	Jul. 26.68	4.0	—22.5	3-4	Good	R.A.M.	See 2004?, 2202
2821	Jul. 20.64	10.5	—21.0	5	Good	M.G.	
2822	Jul. 26.58	17.4	+ 4.5	7	Good	M.G.	See 2061?
2823	Jul. 22.64	19.0	—46.0	5-6	Good	M.G.	See 1237?, 2824
2824	Jul. 20.64	20.0	—43.5	5-6	Good	M.G.	See 2823
2825	Jul. 26-28c	25.0	—55.5	6	Good	R.A.M.	
2826	Jul. 26.58	30.5	—34.3	4	Good	M.G.	
2827	Jul. 26.58	31.7	—17.0	4	Good	M.G.	See 2005?
2828	Jul. 22.64	37.5	— 1.0	5-6	Good	M.G.	
2829	Jul. 22.64	51.5	—32.5	8-9	Good	M.G.	
2830	Jul. 22.64	57.5	+ 4.5	4	Good	M.G.	
2831	Oct. 23.64	60.0	+ 3.7	3-4	Good	R.A.M.	See 102?, 273?,
2832	Jul. 26.68	68.0	—54.0	4	Good	R.A.M.	and 723?
2833	Jan. 24.55	149.5	—24.5	5-7	Good	M.G.	
2834	Jan. 24.55	188.0	—38.5	4-5	Good	M.G.	
2835	Jan. 24.55	198.0	—23.5	6	Good	M.G.	
2836	May 24.50	246.0	—39.0	3-5	Good	M.G.	

A.M.S. No.	1927	α	δ	No of Meteors	Wt.	Observer	Remarks
2837	May 6.60	310.0	—32.0	4	Good	M.G.	See 2180?
2838	Jul. 26.58	313.5	—19.0	13-15	Excel.	M.G.	See 2841?,2839?
2839	Jul. 23.47	314.0	—20.0	5-6	Good	M.G.	See 2838?
2840	Jul. 23.47	315.0	—42.0	4	Good	M.G.	
2841	Jul. 28.60	315.5	—22.5	5-6	Good	M.G.	See 2838?,2217?
2842	Jul. 18.47	316.8	—17.8	2	Good	M.G.	One stat. met.
2843	Jul. 26.58	319.5	—30.0	7-9	Good	M.G.	
2844	Jul. 28.60	321.0	—18.7	9	Good	M.G.	See 1117?,2748?,
2845	Jul. 26.58	322.5	—41.5	4	Good	M.G.	and 2760?
2846	Jul. 20.64	324.5	—17.0	4-5	Good	M.G.	δ Aqr.
2847	Jul. 28.60	325.0	—14.0	4-5	Good	M.G.	δ Aqr.
2848	Jul. 22.64	325.5	—15.2	5-7	Good	M.G.	δ Aqr.
2849	Jul. 26.58	327.5	—15.0	5	Fair	M.G.	δ Aqr.
2850	Jul. 26.58	330.0	—14.0	4-6	Good	M.G.	δ Aqr.
2851	Jul. 20.64	334.7	—35.5	5	Good	M.G.	
2852	May 3.69	335.0	— 1.5	10-12	V.Good	R.A.M.	η Aqr.
2853	May 3.60	336.3	— 0.8	8	Good	M.G.	η Aqr.
2854	Jul. 28.60	337.0	—12.0	6	Good	M.G.	δ Aqr.
2855	May 6.60	337.5	0.0	5	Poor	M.G.	η Aqr.
2856	May 5.60	337.5	— 0.5	6	Good	M.G.	η Aqr.
2857	Jul. 22.64	339.0	—33.0	6	Good	M.G.	See 2000?,2860?
2858	Jul. 22.64	339.6	—19.0	6-7	Good	M.G.	δ Aqr.
2859	Jul. 23.47	340.0	—20.0	5	Excel.	M.G.	δ Aqr.
2860	Jul. 26.58	340.0	—29.0	11-17	Good	M.G.	See 2749,2772,2861
2861	Jul. 28.60	341.0	—31.5	6-8	Good	M.G.	See 2008?,2772,2860
2862	Jul. 26.58	341.7	—17.4	9	Good	M.G.	δ Aqr.
2863	Jul. 28.70	342.0	—18.0	10	Good	R.A.M.	δ Aqr.
2864	Jul. 26.68	342.0	—17.5	6	Good	R.A.M.	δ Aqr.
2865	Jul. 28.60	342.3	—17.5	27	Excel.	M.G.	δ Aqr.
2866	Jul. 28.60	342.7	—17.2	1	Good	M.G.	Stat.met.;δ Aqr.
2867	Jul. 31.58	344.0	—16.0	14	Good	M.G.	δ Aqr.
2868	Jul. 20.64	348.0	—32.0	5-7	Fair	M.G.	
2869	Jul. 28.70	349.5	— 3.0	10	Good	R.A.M.	
2870	Jul. 26.58	351.3	—18.7	6	Good	M.G.	δ Aqr.

Observers: S. Bunch, M. Geddes, C. F. Kingsley, R. A. McIntosh, O. E. Monnig, C. P. Olivier, C. M. Pegues.
The radiants for 1933 were derived by R. A. McIntosh.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1935 November 5.

The Path of the Archie Meteor

By C. C. WYLIE

This spectacular daylight meteor fell with detonations at about 4:30 P.M., 90th meridian time, August 10, 1932. Several meteorites were discovered near the town of Archie, Missouri. Our announcement of this fall appeared in *Contributions of the University of Iowa Observatory*, No. 4, page 120 (POPULAR ASTRONOMY, January, 1933). Professor E. S. Haynes of the University of Missouri published a preliminary report in POPULAR ASTRONOMY, Vol. 43, pages 181-184, 1935. The data for determination of path are not as well arranged as we have obtained for some meteors, but are remarkably complete for a meteor dropping meteorites. An unusual number of trained persons have had a hand in the study of this meteor. Five persons with graduate courses in astronomy assisted in interviewing the observers. Five persons with graduate courses in both mathematics and astronomy have made independent solutions for the radiant. These were not approximations

using a few reports, but real solutions using all data selected as reliable. The results of the different computers are in excellent agreement.

Because of the interest in this meteor, we have solved for the radiant by grouping the individual observations into normal places. We expect to have this completely checked and ready for publication at an early date; but in the meantime we have thought it advisable to publish the data for the path. The following table gives the data which were sent to Mr. H. H. Nininger, for the meeting of the Society for Research on Meteorites, in June, 1935.

Longitude of bursting point	94° 26′.2 ± 0.4
Latitude of bursting point	38 29.8
Height of bursting point	10.8 miles
Longitude of appearance	94° 43′.1
Latitude of appearance	38 28.3
Height of appearance	32.5 miles
Length of path	27.7 miles
Projected length of path	16.0 miles
Apparent velocity	10.8 miles
Heliocentric velocity	21.3 miles
Azimuth from south of uncorrected radiant	89°.6 ± 1°.3
Altitude of uncorrected radiant	54.5 ± 0.7
Right ascension of corrected radiant	157° 39′.4
Declination of corrected radiant	+29 14.8

University of Iowa, October 20, 1935.

Contributions from the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD, President, *and* H. H. NININGER, Secretary

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Compiled by FREDERICK C. LEONARD *and* ROBERT W. WEBB

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Notes from Amateurs

Cleveland Astronomical Society

The first meeting of the Cleveland Astronomical Society for the season was held on October 18 at the Warner & Swasey Observatory under the direction of Dr. J. J. Nassau, the subject being "The Autumn Sky and the Stars Mira and Algol."

The Telescope Makers Group met on Friday, October 11, at 8:00 and planned to meet from then on every two weeks. The work is under the direction of Sheldon Towson whose photograph many will remember in "Amateur Telescope Making."

Further meetings of the Astronomical Society are arranged for November 15 at the Warner & Swasey Company to inspect the 82-inch mirror and mounting being made for the University of Texas, the second largest reflector in the world.

On January 17, the first of three lectures: "What we learn from the Color

and Brightness of Stars," will be given.

Please mail your dues of $1.00 at once to Mrs. H. T. McMyler, 1908 Janet Avenue, Cleveland Heights, Ohio. Members are welcomed from the surrounding district.

DON H. JOHNSTON.

14 Lincoln Drive, Cleveland, Ohio.

Cleveland Astronomical Society

As guests of the Warner & Swasey Company our Society was privileged on the evening of November 15 to view the new 82-inch reflector now nearing completion in their plant. Destined for the McDonald Observatory on Mt. Locke, Texas, the massive instrument will still require six months to finish. Professor J. J. Nassau, director of the Warner & Swasey Observatory of Case school, explained the operation of the telescope. Mr. Seeley gave us moving pictures of dome erection and Texas atmosphere. A small working model of the observatory intrigued all, especially the ladies of our group. Mr. Lundin then conducted us to the great grinding machine where the huge mirror rested on the table. The polishing is nearly finished and the difficult process of figuring will soon be taken up. We felt privileged to listen to this master of an exacting art. Nearly 150 members and guests attended, making this a record meeting for our Society.

DON H. JOHNSTON.

14 Lincoln Drive, Cleveland, Ohio.

Amateur Telescope Makers of Chicago

The September meeting of the Amateur Telescope Makers of Chicago was held on the afternoon of Sunday the eighth, in the Adler Planetarium and Astronomical Museum, Chicago. Professor Arthur Howe Carpenter, president of the club, described his visit to Pasadena where he met Russell W. Porter and saw the preparations made for working the great 200-inch mirror, also several models of the mounting which is to support it. He also told us of the new process of correcting mirrors by depositing different thicknesses of aluminum where required. The principles of the Schmidt telescope were also explained.

On August 24 the club had an outing at Joseph E. Boehm's summer home at Lake Geneva. Mr. Boehm has finished his 14-inch except for some work on the slow motions and it is a splendid job. The mounting is the open fork type and this time an amateur has made his mounting heavy enough. The instrument and mounting weigh about 1000 pounds and rest on a massive concrete base which goes down about ten feet to the gravel bed. It has a clock drive and an observatory with a sliding roof. We looked at many of the clusters including M13 which is a beautiful spectacle through the 14-inch. Mr. Armfield and about four automobile loads of the Milwaukee group were there and we had a most enjoyable time.

WM. CALLUM, *Secretary.*

1319 W. 78th Street, Chicago, Illinois.

Amateur Telescope Makers of Chicago

The Amateur Telescope Makers of Chicago met at Yerkes Observatory on Saturday afternoon, October 5. We gathered in the dome of the 40-inch, and Dr. Struve told us of the work of the great telescope. We then went to the library and listened to an illustrated talk by Dr. Struve. Dr. Moffitt then conducted us to the machine shop and we were shown some of the equipment which is being

made for the 82-inch reflector of the McDonald Observatory. We returned to the dome of the 40-inch and were permitted to look at the moon through this instrument. We then went to the 24-inch reflector and were shown Saturn and the moon by Dr. Van Biesbroeck.

Mr. Armfield and a number of the Milwaukee Astronomical Society and Mr. Preucil and some of the Joliet Astronomical Society were with us.

We had a most enjoyable and instructive meeting and our members greatly appreciate the courtesies shown us and the privilege of looking through the great instruments.

WM. CALLUM, *Secretary.*

1319 W. 78th Street, Chicago, Illinois.

Amateur Telescope Makers of Chicago

The monthly meeting of the Amateur Telescope Makers of Chicago was held in the Adler Planetarium and Astronomical Museum, Chicago, on the afternoon of Sunday, November 3.

Edwin P. Martz, Jr., delivered an address on "Planetary Observation." He told us that although atmospheric conditions in cities are generally considered to be unfavorable for work on the planets, the presence of a certain amount of dust in the atmosphere actually tends to make the seeing steadier. As in other fields of astronomy the patience and skill of the observer overcome many obstacles. The importance of watching the planet for extensive periods was emphasized as during moments of good seeing details flash out and may be sketched and recorded. One of his telescopes is a 6-inch reflector with a F15 mirror which was made by Mellish. This instrument is specially suited for lunar and planetary work.

Mr. Martz is the leader of the planetary section for the Wisconsin, Northern Illinois region and invites anyone interested in this work to communicate with him. His address is 726 N. Elmwood Avenue, Oak Park, Illinois.

WM. CALLUM, *Secretary.*

1319 W. 78th Street, Chicago, Illinois, November 15, 1935.

The Third Year of the Rhode Island "Skyscrapers"

The annual dinner of the Skyscrapers Amateur Astronomical Society of Rhode Island was held in Faunce House, Brown University, on June 6, 1934. Following this, the annual election and business meeting was held at Ladd Observatory. The following officers were elected: President, Dr. Harry L. Koopman; vice-presidents, Mr. Harry A. MacKnight and Mr. Ralph C. Patton; secretary-treasurer, Miss Grace Cragin.

The program of the third year was as follows:

July 27, 1934. Outdoor meeting at the home of Mr. Frank P. Sherman, Johnston, Rhode Island.

August 10, 1934. Visit to the Oak Ridge Station of the Harvard College Observatory.

August 30, 1934. Outdoor meeting at the home of Mr. Franklin S. Huddy, Chepachet, Rhode Island.

September 12, 1934. Mr. Paul Eberhart of Ladd Observatory spoke on "A Summer at Yerkes Observatory."

September 29, 1934. A large delegation attended the first annual convention of the Amateur Telescope Makers of Boston at Oak Ridge Station, Harvard College Observatory.

October 1, 1934. Mr. C. F. Stiles of Boston spoke on "Photographing Meteor Spectra."

November 7, 1934. Dr. Fred L. Whipple of Harvard College Observatory spoke on "Celestial Photography."
December 3, 1934. Miss Maribelle Cormack spoke on "Time."
January 9, 1935. Mr. H. A. MacKnight spoke on "The Grinding and Testing of a Telescope Mirror."
February 4, 1935. Dr. W. V. MacGilvra of Worcester, Massachusetts, spoke on "The Eye as an Optical Instrument."
March 6, 1935. Mr. Donald S. Reed spoke on "Nova Herculis."
April 1, 1935. Dr. A. B. Focke of Brown University spoke on "Aluminizing Astronomical Mirrors," then demonstrated the modern method of evaporation.

On May 1, 1935, after the annual dinner, Dr. Harlow Shapley, Director of Harvard College Observatory, spoke on "Galactic Explorations."

Among the projects planned and started during the third year of the organization, were the acquisition of a library; the sponsoring of an astronomical radio broadcast; the making of a 400-foot film of 16 mm motion pictures showing the making of reflecting telescopes by amateurs; and the construction, in coöperation with Ladd Observatory of Brown University, of a Schmidt camera of focal ratio f/1. Professor C. H. Smiley of Brown University designed the camera and Mr. H. A. MacKnight and Mr. D. S. Reed are constructing it.

The Joliet Astronomical Society

The Joliet Astronomical Society began its fourth year of activity on October 15, 1935. Robert L. Price, organizer of the group, became president, succeeding Frank M. Preucil who became program chairman. Almond Fairfield was elected reporter on astronomical progress and George Bockrath, coördinator of research. William Schofield continues as secretary while Dr. H. D. Cohn was elected treasurer.

Dr. Arthur Howe Carpenter was the guest speaker of the society on October 29 and described his visit at Pasadena during the summer, where he was the guest of R. W. Porter and others who are guiding the destinies of the 200-inch telescope.

Plans for the year include a series of coördinated programs, several of which will be presented by guest speakers, some work in meteor observations, coöperation in the nova survey originally proposed by Mr. Preucil, and some variable star work.

WILLIAM SCHOFIELD, *Secretary.*

Joliet, Illinois, November 8, 1935.

Asteroid Notes

By HUGH S. RICE

The diagrams and remarks in recent numbers of POPULAR ASTRONOMY cover the main objects observable this month. Vesta is seen in the southwest after sunset. Juno is found in Cetus south of α Piscium. They can be observed with small telescopes by aid of our charts in the June-July and October issues.

A minor planet discovered by Hubble photographically at Mount Wilson about September 1, known as "Hubble's Object" at first, is called planet 1935 QN, until it becomes better known and receives a name. It is in Cassiopeia in the middle of December but, being of magnitude 15, is entirely out of ordinary reach. It is unusual in having such a high declination.

Planetoids are not discovered in such numbers now as they were a few years ago. This is probably not because we have discovered all of them, but because we

have picked up most of the sizable ones; there are likely thousands more, which are exceedingly small objects, beyond our ability with present equipment. Professor Leuschner estimates there are 50,000 asteroids; Professor Russell in his new book, "The Solar System and its Origin," quotes Baade's recent estimate of 30,000.

These Notes will be continued in the January number, with details of the observable minor planets during the first of the year.

American Museum of Natural History, New York, November 21, 1935.

General Notes

Dr. Herbert Dingle, assistant professor of astrophysics in the Imperial College of Science, South Kensington, is to give a course of ten Lowell Institute Lectures at Boston, Massachusetts, beginning January 3. Dr. Dingle's subject will be "Through Science to Philosophy." (*Nature,* Nov. 2, 1935.)

Dr. N. T. Bobrovnikoff, acting director of the Perkins Observatory, Delaware, Ohio, has received from the American Academy of Arts and Sciences a grant of six hundred dollars to be used for the construction of a grating spectrograph to be used at the Cassegrain focus of the 69-inch reflector, for the purpose of investigating stellar spectra in the visual and infra-red regions. (*Science,* November 1, 1935.)

Mr. J. H. Skaggs, amateur astronomer and printer, died of pneumonia in a hospital in Berkeley, California, on November 3. For many years he had been active in both the Eastbay Astronomical Society and the American Association of Variable Star Observers, using his 5-inch telescope not only for his own observing but also very effectively to arouse interest in others, especially young people. Variable Comments of the A.A.V.S.O. and the Bulletins of the Eastbay Astronomical Association came from his press.

He was known to astronomers at home and abroad because of the convenient Julian Day Calendar which he printed and distributed at his own expense to observatories and to observers of variable stars.

The Rittenhouse Astronomical Society of Philadelphia held its monthly meeting on Friday, November 8, in the Hall of The Franklin Institute, Parkway at Twentieth Street. A lecture entitled "New Knowledge of the Moon's Surface" (illustrated) was given by Dr. Fred E. Wright, Chairman of the Moon Committee of the Carnegie Institution of Washington.

Southern Stars, the Journal of the New Zealand Astronomical Society, and already referred to in this magazine, with its issue for October, 1935, has completed its first year. The Society and the editor, Mr. I. L. Thomsen are to be congratulated upon the success of the magazine. It speaks well for the interest in astronomy in what seems to us to be a far-off land.

A Bright Meteor.—On Sunday, May 26, about 9:45, while watching an unusually bright star-lit sky I noticed a sudden flash of light, followed immediately by the appearance of the fireball. It traveled very slowly, trailing its fiery red light for what seemed about three minutes before going out.

The Oak Ridge Observatory in Harvard, Massachusetts, just a few miles

north of my town, reports the meteor as coming from under the Big Dipper. It was probably no larger than a man's hand when it finally reached the lower atmosphere and had worn itself out.

LESLIE W. FIELD.

Clinton, Massachusetts.

Variations of the Ultra-Violet Solar Radiation

It is very difficult to determine whether the observed variations of the total solar radiation have a claim to reality, because they are very small and because the observational errors often are larger than the measured values. The situation is different if we regard the ultra-violet radiation.

When Abbot[1] was examining his observational material in 1925 he found that the variation was larger in the part of the spectrum which is situated between λ 5000 and λ 3500. In the neighboring section of λ 5000 and λ 20,000 scarcely any fluctuation could be discovered. One could say that the values were either real or caused by an alternating absorption of the atmosphere of the earth.

In 1925 a very fine work was published by E. Pettit.[2] He compared the intensities of the radiation at λ 3100 and λ 5000. He used thermocouples with filters (a silver-film, a gold-film with a green celluloid-filter). The provisional result gave an extreme change of 83%. This value was later corrected[3] to 57%. W. E. Bernheimer[4] in 1928 discussed all the material once more and found that the change was 26%, if he omitted the trial observations of 1924. Pettit discovered that the curve of change was the same whether the measures were reduced to the surface of earth or to a point outside of the atmosphere.

It was not impossible that the observed appearance was related to the contents of ozone of the air. But Pettit proved that there was no important relation. This effect would be uncertain because the content of ozone is variable, as was shown by G. M. B. Dodson and D. N. Harrison.[5] Pettit thought that it only had an influence on wave-lengths smaller than those measured by him.

It seemed as if the variation had a real reason. But it was discovered that the turbidity of the atmosphere has a connection with the total absorption and, indeed, so that ultra-violet radiation was very large in winter (very pure air!), but small in summer (turbid air!). Bernheimer[6] proved that the observed variation of the ultra-violet solar radiation for the main part does not have its issue in the sun itself, but in the earth's atmosphere with its changing turbidity. Therefore we are not yet entitled to say the sun is a variable star.

G. R. MICZAIKA.

Berlin-Neutempelhof, 1934 November 27.

[1] Smithson. Misc. Coll., 77, No. 5, p. 25 (1925).
[2] P. A. S. P., 38, p. 21 (1926).
[3] P. A., 34, p. 631 (1926).
[4] Die Naturwissenschaften, 16, p. 26 (1928).
[5] Proc. R. Soc., 110, p. 660 (1926).
[6] Lund Circular No. 2 (1931).

Correction.—The blocks used on pages 554 and 555 (November issue) are interchanged. Please read legend on page 554 as applying to the network which appears on page 555, and *vice versa*.

Book Reviews

Tafeln zur Theoretischen Astronomie von Julius Bauschinger, second edition revised by Professor Gustav Stracke. (Published by Wilhelm Engelmann, Leipzig.)

The first edition of this work prepared by Professor Julius Bauschinger, recently deceased, was published in 1901. This second edition is revised in keeping with developments in computational work since that time. Consequently some of the tables of the earlier edition have been omitted and in their places are found new tables.

The first 46 pages are given to an explanation of the several tables. Many examples are worked out as illustrations. The remaining 140 pages are given to the tables themselves, sixty-nine in number. These do not include the trigonometric functions and logarithms nor the logarithms of numbers. However, the final two pages give an extensive bibliography of tables of these functions and simpler tables.

This volume because of its up-to-date-ness and its comprehensiveness constitutes a most valuable, one might say an indispensable, part of the equipment of all workers in theoretical astronomy.

Lohse Tafeln, revised by P. V. Neugebauer. (Wilhelm Engelmann, Leipzig. Six marks.)

The first edition of this work was published in 1909. The present one bears the date, New Year's Day, 1935. There are five separate tables included, viz., (1) The reciprocals of numbers, (2) The natural values of the six trigonometrical functions for each hundredth of a degree, (3) Table of square roots, (4) Table for converting hours and minutes into degrees, and (5) Table for changing minutes and seconds of arc into fractional parts of a degree.

As a concession to English computers the introduction which is briefly explanatory of the tables is repeated in English. The tables are well and clearly printed, and will be very serviceable where computations are to be made by the use of calculating machines instead of by the method of logarithms.

General Astronomy, by H. Spencer Jones. (Longmans, Green and Co., New York. $3.75.)

This textbook, a revision of one which appeared in 1922, bears the publication date of September, 1934. In the preface the author calls attention specifically to a few topics in which the rapid progress of the science has made revision necessary. For example, the number of major planets has been increased through the discovery of Pluto, and some interesting members, notably Amor and 1932 HD, have been added to the known minor planets. Also the photography of the planets in light of different colors, the variability of the earth's rotation, the age of the earth from radioactive minerals, and new theory relating to sun-spots are items which have been treated in the revision. Five chapters are now devoted to a discussion of the present status of stellar astronomy instead of three chapters in the earlier edition.

The book is beautifully illustrated with twenty-seven full page plates printed on special paper. The first of these, however, unfortunately bears an erroneous title, since it is obviously a photograph of the 36-inch Lick and not the 40-inch

Yerkes refractor. In addition to the plates there are numerous line drawings in the text which add greatly to the clearness of the presentation.

The volume contains an enormous amount of astronomical information. It would be difficult to find a topic in astronomy on which one cannot find here an extensive, thorough and scholarly discussion. Although it is intended as a text for class instruction, it is equally useful as a reference work. It can be relied upon for up-to-date information at present, and, no doubt, when new discoveries cause it to become out of date, we may expect a second revision.

If the curiosity of any one should be aroused by the item "Baily's beard" in the index, he may find, by looking up the reference, that the well-known "Bailey's Beads" were meant. His confusion, however, is not completely removed, for here it is said that "Bailey's Beads . . . were fully described by Baily, who observed them at the annular eclipse of 1836."

It is not possible to mention here in detail the many merits of this book. It is self-evident, however, that a work which comes from the pen of the person who has attained the position of Astronomer Royal of England must surely enrich the literature of the far-reaching science of astronomy.

Guide to the Constellations, second edition, by Barton and Barton. (Whittlesey House, McGraw-Hill Book Company, Inc., New York. $3.00.)

The first edition of this work appeared in 1928 and a review of it was given in Volume 36, page 387, of this publication. As indicated in the preface to the second edition the text has been changed only to the extent of bringing some of the figures into agreement with present knowledge, and to record the most important advances, such as the discovery of Pluto, since the first edition was printed.

The paper used is of excellent quality and the charts and diagrams are clearly done. The blue background for the sky charts lends an interesting suggestion of reality.

The book consists of seventy large sized pages, and an extensive index. It is worthy of high recommendation.

Astronomy: A Text Book, by John Charles Duncan. Third Edition, xvii +448 pp., 67 plates, 183 figures. Harper & Brothers, Publishers, New York, 1935.

This new edition of Dr. Duncan's deservedly popular book is marked especially by a revision of the material in the final chapters to conform with current opinion and practice. The first seventeen chapters bear the same titles and contain the same amount of material as did the corresponding chapters of the second edition (1930). The new Chapter XVIII contains the discussions of only the galactic and globular star clusters and the gaseous (including the obscure) nebulae; Chapter XIX, "The Galactic System," replaces the old "Cosmography" chapter; Chapter XX, happily (and unashamedly!) titled "Beyond the Milky Way," is new, and includes all that can profitably be said about the external galaxies, but it is hoped that in a later edition the author will go still farther and eliminate even a casual use of the word "nebula" in place of the more specific term "galaxy."

Chapter I contains a new page devoted to a description of the Zeiss planetarium, but is otherwise unchanged; Chapters II and III remain unchanged, except for a rearrangement of the material of the latter section to render the discussion more logical. The only change in Chapter IV appears to be the statement of the new value for the velocity of light. A new plate of the third quarter moon accompanies Chapter V, but the reviewer feels that the omission of the familiar

Hooker telescope picture of Mare Imbrium and the beautiful northern mountain ranges is too high a price to have paid. No distinction is made between igneous and volcanic activity as an agent for production of lunar craters, hence all the author's sentiment seems to be with the meteoric theory. To Chapter VI there has been added a short table of some coming solar eclipses, with their durations and places of visibility. Chapters VII and VIII remain unchanged, except for a brief mention of Lyot's work on the solar corona without eclipse. The orbit of Pluto has been included in Fig. 118 of Chapter IX, but the legend has not been changed accordingly. Chapter X still contains the long and unnecessary section on Newton's proof of the law of areas; the inclusion of W. H. Pickering's name in connection with the discovery of Pluto will be frowned on by many, but it is only fair, for, after all, if greater faith in his prediction had prevailed, Pluto would have been discovered ten years earlier. Chapter XI includes the new observations on the atmospheres of Venus, Mars, Jupiter, and Saturn; the reviewer would suggest a more definite separation of the various bodies discussed here, and the lumping into a final paragraph the discussion of all the planets as abodes for life; the lack of oxygen on Mars renders that planet as inhospitable as Jupiter or Saturn. Chapter XII contains no new material, but some small mention might have been made of Millman's results and conclusions concerning meteor spectra. Chapter XIV is quite like the old one; however, it omits detailing Secchi's original spectral classification scheme; further modernization could be accomplished by finding new designations to replace the old a, b, c spectral subclasses, and "Detroit Observatory" should be replaced by "Observatory of the University of Michigan." A short new section in Chapter XV tells what is known and believed about stellar rotation. Fig. 166 remains inaccurate in that the durations of the two minima of the eclipsing variables are not shown to be equal; also, the statement on page 343, that "if secondary minima occur halfway between primary minima, the orbit is circular," is not exclusively true. The definition of the "distance modulus" leads off Chapter XVI, which contains, in place of the old Seares standby, a new and "cleaner" Russell diagram based on more than 4000 Mount Wilson spectroscopic parallaxes (and hence omits the B stars). The chapter on variable stars has not been altered, and it could very well be improved in a later edition. The homogeneity of Chapter XVIII has been greatly improved by the relegation of the galaxies to a later section, and Chapter XIX has been amplified by excellent discussions of Hubble's zone of avoidance, the system outlined by globular clusters, and the rotation of the galaxy. The final chapter includes much more material than formerly allotted to the galaxies, including a good paragraph on the determination of the distances; however, one looks in vain for the common-sense explanation of the recession of the galaxies—those moving fastest got farthest away.

Space does not permit more detailed discussion of several topics which might have been included. The feeling of the reviewer is that the book remains the best treatment of the subject for the beginning student, and it should find a wide adoption in college class rooms and in libraries.

Roy K. Marshall.

Wilson College, Chambersburg, Pennsylvania.